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David N. Lorfing
Manager, Licensing

September 17, 2009

RBG-46958

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: River Bend Station - Unit 1
Docket No. 50-458
License No. NPF-47
Fifteenth Fuel Cycle Core Operating Limits Report (COLR)

Dear Sir or Madam:

Enclosed is Revision 2 of the River Bend Station (RBS) Core Operation Limits Report (COLR) for the fifteenth fuel cycle. This report is submitted in accordance with Technical Specification 5.6.5 of Appendix A of the Facility Operating License NPF-47.

There are no commitments in this letter. For further information, contact myself, David Lorfing at (225) 381-4157.

Sincerely,

Manager, Licensing
River Bend Station - Unit 1

DNL/bmb

A001
NRR

cc: Regional Administrator
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612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

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U. S. Nuclear Regulatory Commission
Attn: Mr. Alan B. Wang
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Core Operating Limits Report

Cycle 15

Revision 2

RIVER BEND STATION, CYCLE 15

CORE OPERATING LIMITS REPORT (COLR)

PREPARED BY:	**Phu V. Vo *** **Responsible Engineer**	**Date:**	
REVIEWED BY:	**James P. Head*** **Review Engineer**	**Date:**	
APPROVED BY:	**Frederick H. Smith*** **Manager – Nuclear Engineering**	**Date:**	
APPROVED BY:	**Dennis P Wiles*** **Director, Engineering** **River Bend Nuclear Station**	**Date:**	
APPROVED BY:	**N/A** **On-site Safety Review Committee** **River Bend Nuclear Station**	**Date:**	

* **Signatures and dates are documented in EC 16263**

TABLE OF CONTENTS

INTRODUCTION AND SUMMARY

This report provides Cycle 15 values for the following Technical Specifications:

1. AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) limits,
2. MINIMUM CRITICAL POWER RATIO (MCPR) limits,
3. LINEAR HEAT GENERATION RATE (LHGR) limits,
4. FRACTION OF CORE BOILING BOUNDARY (FCBB),
5. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Simulated Thermal Power - High Allowable Values,
6. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Simulated Thermal Power time constant.
7. PERIOD BASED DETECTION SYSTEM (PBDS) region boundaries.

Technical Specification section 5.6.5 requires these values be determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met. The references for the pertinent methodology used by AREVA are listed in the section titled Analytical Methods Documents.

This report also provides Cycle 15 values for the following Technical Requirements:

1. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Neutron Flux Power - High Allowable Values and Nominal Trip Setpoints[1],
2. CONTROL ROD BLOCK INSTRUMENTATION APRM Flow Biased Neutron Flux High limits.

The Cycle 15 COLR supports power operation with FHOOS, FFWTR, PROOS, SLO, EOC-RPT, and TBOOS INOPERABLE and Loop Manual Operation. In addition to the specific requirements listed in the Sections 3.2.1 to 3.2.4, the APLHGR, MCPRp and LHGR-p limits as shown in Appendix A shall be used for the applicable modes of operation. For Loop Manual Operation, the MCPR-f as shown in Appendix A shall be used.

The reload analyses were performed in accordance with AREVA methodology and its applicability to Cycle 15 was confirmed by Reference 1.

[1] Note that for Figures 13 to 20, the Nominal Setpoints should be used for indicating the entry into a particular stability region as allowed and appropriate actions be taken prior to the entry

CONTROL RODS

The River Bend core utilizes the GE design control rods, non GE design CR-82M and CR-82M-1 bottom entry cruciform control rods. These Control Rod designs are discussed in more detail in Reference 3.

DEFINITIONS

MOC – Middle of Cycle (Core Exposure 29,641 MWd/MTU).

EOC – End of Cycle (Core Exposure 30,877 MWd/MTU).

EEOC – Extended cycle with Increased Core Flow (Core Exposure 31,191 MWd/MTU).

EEEOC – Extended cycle with Increased Core Flow and Final Feedwater Temperature Reduction (Core Exposure 32,100 MWd/MTU).

FFWTR – Final Feedwater Temperature Reduction.

FHOOS – Feedwater Heater Out of Service.

PROOS – Pressure Regulator Out of Service.

SLO – Single Loop Operation.

TBOOS –Turbine Bypass Out of Service

AREVA – AREVA NP Inc.

EOC-RPT – End of Cycle Recirculation Pump Trip

REFERENCE CORE LOADING PATTERN – The Core Loading Pattern Used for Reload Licensing Analysis.

REVISION HISTORY

Revision 0 is to provide the thermal limits for Cycle 15 power operation.

Revision 1 implements thermal limits changes for LAR 07-09, Rev. 0, "Main Turbine Bypass System Out-Of-Service".

Revision 2 increases the licensed core exposure from 31,712 MWD/MT to 32,100 MWd/MT (EEEOC) reflecting extension of RFO15 from Spring 2009 to Fall 2009

TECHNICAL SPECIFICATION 3.2.1

POWER DISTRIBUTION LIMITS

AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

The limiting APLHGR (sometimes referred to as Maximum APLHGR, or MAPLHGR) as a function of AVERAGE PLANAR EXPOSURE is given in Figure 2. They were determined with the AREVA methodology (Reference 1). Core location by fuel type is provided in Figure 1 and is the reference core loading pattern in Reference 1.

TECHNICAL SPECIFICATION 3.2.2

POWER DISTRIBUTION LIMITS

MINIMUM CRITICAL POWER RATIO (MCPR)

The MCPR limits for use in Technical Specification 3.2.2 for flow dependent MCPR ($MCPR_F$) and power dependent MCPR ($MCPR_P$) (Reference 1) are shown in Figure 4, 5, 6 and 7, respectively. Figure 27 is used in lieu of Figure 4 when the Reactor Recirculation System is operating in Loop Manual Mode. The most limiting value from the applicable $MCPR_f$ and $MCPR_p$ figures is the operating limit. These values were determined with AREVA methodology as described in Reference 1 and are consistent with a Safety Limit MCPR from Technical Specification 2.0.

TECHNICAL SPECIFICATION 3.2.3

POWER DISTRIBUTION LIMITS

LINEAR HEAT GENERATION RATE (LHGR)

The limiting LHGR value for ATRIUM-10 as a function of PELLET EXPOSURE is given in Figure 3. Core location by fuel type is provided in Figure 1 and is the reference core loading pattern in reference 1. Thermal power and core flow dependent multipliers for ATRIUM-10 are provided in Figures 8, 9 and Figure 10, respectively. The value of the exposure dependent limit is reduced by the value of the multiplier at a given offrated power or flow condition.

TECHNICAL SPECIFICATION 3.2.4

POWER DISTRIBUTION LIMITS

FRACTION OF CORE BOILING BOUNDARY (FCBB)

Restricted Region Boundary

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow. The Restricted Region boundary is defined by the "non-setup" APRM Flow Biased Simulated Thermal Power - High Control Rod Block Setpoints, which are a function of reactor recirculation drive flow.

The Restricted Region boundaries as a function of aligned drive flow are given in Figures 13 through 16 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High Scram setpoints as a function of aligned drive flow are given in Figures 13 through 16. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50° F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50° F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL SPECIFICATION 3.3.1.1

INSTRUMENTATION

REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High scram setpoint Allowable Values are given in Figures 13 through 16 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

APRM Simulated Thermal Power Time Constant

The simulated thermal power time constant for use in Technical Specification Table 3.3.1.1-1, SR 3.3.1.1.14, is (Reference 2):

6 ± 0.6 seconds.

The maximum simulated thermal power time constant for use in Technical Specification surveillance Table 3.3.1.1-1, SR 3.3.1.1.14 is:

6.6 seconds

TECHNICAL SPECIFICATION 3.3.1.3

INSTRUMENTATION

PERIOD BASED DETECTION SYSTEM (PBDS)

Monitored Region Boundary

The Monitored Region Boundaries as a function of core flow are given in Figures 11 and 12.

Restricted Region Boundary

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow. The Restricted Region boundary is defined by the "non-setup" APRM Flow Biased Simulated Thermal Power - High Control Rod Block Setpoints, which are a function of reactor recirculation drive flow.

The Restricted Region boundaries as a function of aligned drive flow are given in Figures 13 through 16 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL REQUIREMENT 3.3.1.1

INSTRUMENTATION

REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High scram setpoint Nominal Trip Setpoints are given in Figures 13 through 16 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL REQUIREMENT 3.3.2.1

INSTRUMENTATION

CONTROL ROD BLOCK INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Neutron Flux - High Limits

The APRM Flow Biased Neutron Flux - High rod block Allowable Values and Nominal Trip Setpoints are given in Figures 17 through 20 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50^{\circ}\,F\,,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50^{\circ}\,F\,,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

REFERENCES

1) (a) RBS Cycle 15 Reload Analysis Report, ANP-2653 Revision 1, December 2007, and (b) AREVA Letter, FAB08-2069, "Transmittal of River Bend Cycle 15 Final Core Loading Report, Revision 1," February 4, 2008.

2) Letter, R.E. Kingston to G. W. Scronce, "Time Constant Values for Simulated Thermal Power Monitor" GFP-1032 November 30, 1995.

3) RBS USAR Section 4.1 and 4.2

4) CEO 2003-00047, "River Bend Station Unit 1 E1A Stability Power Uprate Evaluation."

5) AWW:09:011/FAB09-2158, "River Bend Station Cycle 15 Extended Operation."

ANALYTICAL METHODS DOCUMENTS (TS 5.6.5):

1) XN-NF-81-58(P)(A) Revision 2 and Supplements 1 and 2, RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model, Exxon Nuclear Company, March 1984.

2) XN-NF-85-67(P)(A) Revision 1, Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel, Exxon Nuclear Company, September 1986.

3) EMF-85-74(P) Revision 0 Supplement 1 (P)(A) and Supplement 2 (P)(A), RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model, Siemens Power Corporation, February 1998.

4) ANF-89-98(P)(A) Revision 1 and Supplement 1, Generic Mechanical Design Criteria for BWR Fuel Designs, Advanced Nuclear Fuels Corporation, May 1995.

5) XN-NF-80-19(P)(A) Volume 1 Supplements 1 and 2, Exxon Nuclear Methodology for Boiling Water Reactors – Neutronic Methods for Design and Analysis, Exxon Nuclear Company, March 1983.

6) XN-NF-80-19(P)(A) Volume 4 Revision 1, Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads, Exxon Nuclear Company, June 1986.

7) EMF-2158 (P)(A) Revision 0, Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2, Siemens Power Corporation, October 1999.

8) XN-NF-80-19(P)(A) Volume 3 Revision 2, Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description, Exxon Nuclear Company, January 1987.

9) XN-NF-84-105(P)(A) Volume 1 and Volume 1 Supplements 1 and 2, XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis, Exxon Nuclear Company, February 1987.

10) ANF-524(P)(A) Revision 2 and Supplements 1 and 2, ANF Critical Power Methodology for Boiling Water Reactors, Advanced Nuclear Fuels Corporation, November 1990.

11) ANF-913(P)(A) Volume 1 Revision 1 and Volume 1 Supplements 2, 3 and 4, COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses, Advanced Nuclear Fuels Corporation, August 1990.

12) XN-NF-825(P)(A) Supplement 2, BWR/6 Generic Rod Withdrawal Error Analysis, MCPRp for Plant Operations within the Extended Operating Domain, Exxon Nuclear Company, October 1986.

13) ANF-1358(P)(A) Revision 3, The Loss of Feedwater Heating Transient in Boiling Water Reactors, Advanced Nuclear Fuels Corporation, September 2005.

14) EMF-1997(P)(A) Revision 0, ANFB-10 Critical Power Correlation, Siemens Power Corporation, July 1998.

15) EMF-1997(P) Supplement 1 (P)(A) Revision 0, ANFB-10 Critical Power Correlation: High Local Peaking Results, Siemens Power Corporation, July 1998.

16) EMF-2209(P)(A) Revision 2, SPCB Critical Power Correlation, Siemens Power Corporation, September 2003.

17) EMF-2245(P)(A) Revision 0, Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel, Siemens Power Corporation, August 2000.

18) EMF-2361(P)(A), Revision 0 "EXEM BWR-2000 ECCS Evaluation Model," Framatome ANP Richland, Inc.

19) Deleted.

20) Deleted.

21) Deleted.

22) EMF-CC-074(P)(A) Volume 4 Revision 0, BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2, Siemens Power Corporation, August 2000.

23) EMF-2292(P)(A) Revision 0, ATRIUM™-10 Appendix K Spray Heat Transfer Coefficients, Siemens Power Corporation, September 2000.

24) NEDE-24011-P-A and US Supplement, "General Electric Standard Application for Reactor Fuel."

Table 1. Aligned Drive Flow

$$W_D = \frac{101.209 \cdot \Delta^{40} - 31.028 \cdot \Delta^{100} + 70.181 \cdot W_{\tilde{D}}}{70.181 - (\Delta^{100} - \Delta^{40})}$$

Where:

$W_{\tilde{D}}$ = FCTR card input drive flow in percent rated,
W_D = Aligned drive flow in percent rated,
Δ^{40} = Low flow drive flow alignment setting, and
Δ^{100} = High flow drive flow alignment setting.

FIGURE 1. REFERENCE CORE LOADING PATTERN

	29	31	33	35	37	39	41	43	45	47	49	51	53	55
28	25 27.8	30 0.0	29 15.2	26 28.6	29 20.4	30 0.0	29 21.1	30 0.0	29 18.9	30 0.0	29 18.5	31 0.0	25 29.4	26 34.6
26	30 0.0	26 32.5	30 0.0	29 14.6	30 0.0	26 33.1	30 0.0	26 34.2	30 0.0	26 34.7	30 0.0	29 18.6	26 33.2	26 35.5
24	29 15.0	30 0.0	29 17.0	30 0.0	26 33.6	30 0.0	29 18.8	30 0.0	29 17.4	30 0.0	29 18.0	29 19.8	26 34.3	25 36.1
22	26 28.6	29 14.8	30 0.0	29 16.8	30 0.0	29 20.6	30 0.0	29 15.8	30 0.0	29 16.3	30 0.0	29 18.7	26 34.5	23 38.4
20	29 20.1	30 0.0	26 34.4	30 0.0	25 27.9	30 0.0	26 30.4	31 0.0	26 34.3	30 0.0	29 18.5	29 19.1	26 35.4	
18	30 0.0	26 33.0	30 0.0	29 20.5	30 0.0	29 19.0	31 0.0	29 17.0	31 0.0	29 19.6	30 0.0	25 28.9	26 35.6	
16	29 20.6	30 0.0	29 18.9	30 0.0	26 30.2	31 0.0	26 34.1	31 0.0	26 35.0	31 0.0	29 20.0	26 33.2	23 39.0	
14	30 0.0	26 33.4	30 0.0	29 16.2	31 0.0	29 17.1	31 0.0	29 17.8	31 0.0	29 19.7	26 34.2	26 35.5		
12	29 18.7	30 0.0	29 17.8	30 0.0	26 34.6	31 0.0	26 34.9	31 0.0	25 29.3	26 35.0	23 39.9			
10	30 0.0	26 34.7	30 0.0	29 16.6	30 0.0	29 20.1	31 0.0	29 19.2	26 34.8	23 39.7				
8	29 18.6	30 0.0	29 17.8	30 0.0	29 18.7	30 0.0	29 20.4	26 35.0	25 37.0					
6	31 0.0	29 18.9	29 19.3	29 18.7	29 19.2	25 29.3	26 34.0	25 36.2						
4	26 33.0	26 32.6	26 34.7	26 33.3	26 34.1	25 37.0	22 37.9							
2	26 35.0	26 35.5	26 35.5	23 38.2										

Nuclear Fuel Type
BOC Exposure (GWd/MTU)

Fuel Type	Description	Cycle Loaded	No. Per Quarter core
22	A10-3996B-11G45	12	1
23	A10-3981B-15GV75	12	5
25	A10-3775B-9GV60	13	10
26	A10-3747B-13GV70	13	40
29	A10-3705B-13GV70	14	46
30	A10-3810B-14GV75	15	40
31	A10-3854B-12GV75	15	14

FIGURE 2. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR ATRIUM-10

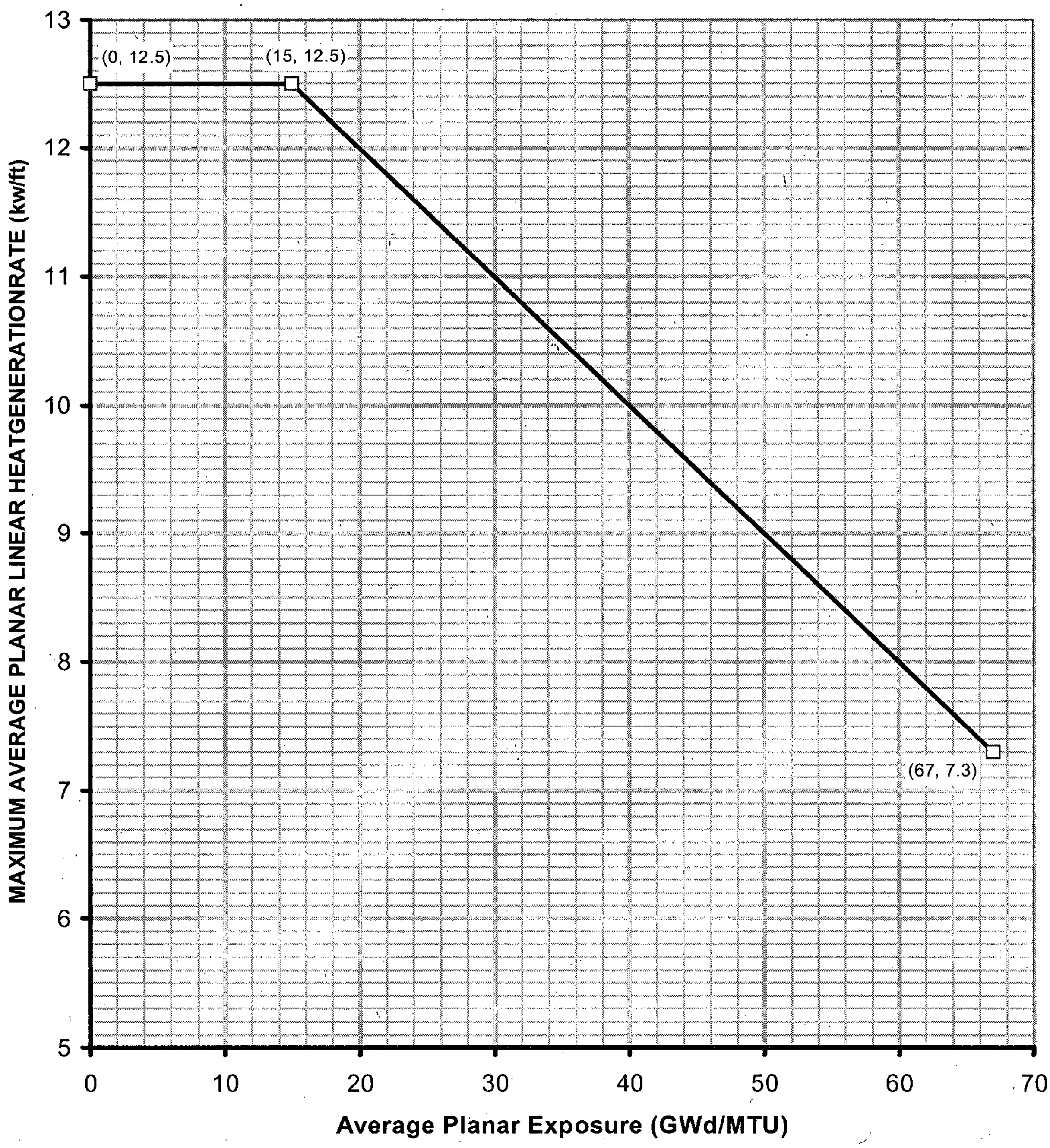


FIGURE 3. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS PELLET EXPOSURE FOR ATRIUM-10

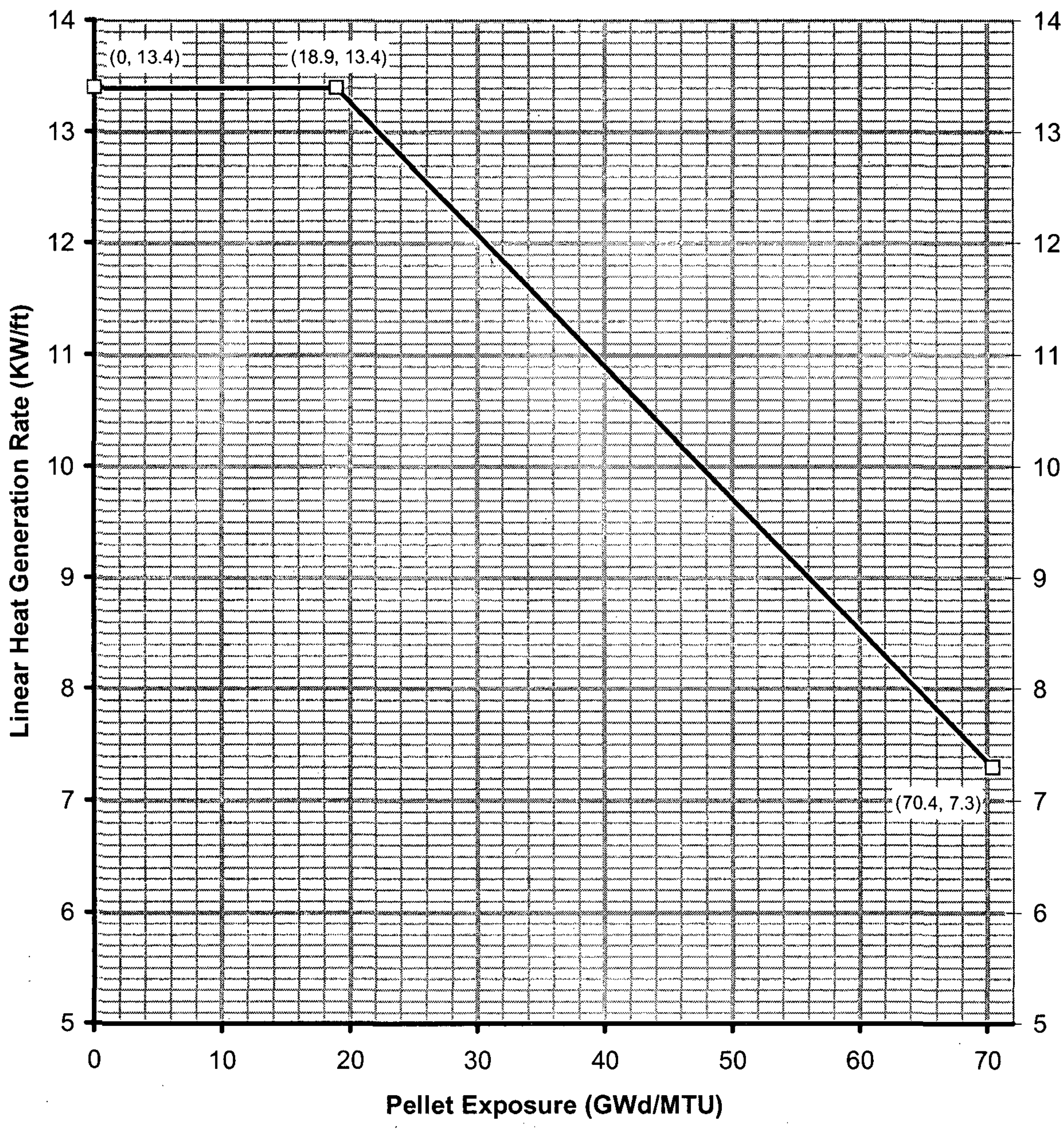


FIGURE 4. OPERATING LIMIT MCPR ($MCPR_F$) VERSUS CORE FLOW FOR ATRIUM-10 FOR RECIRCULATION SYSTEM IN LOOP AUTO CONTROL, ALL EXPOSURES

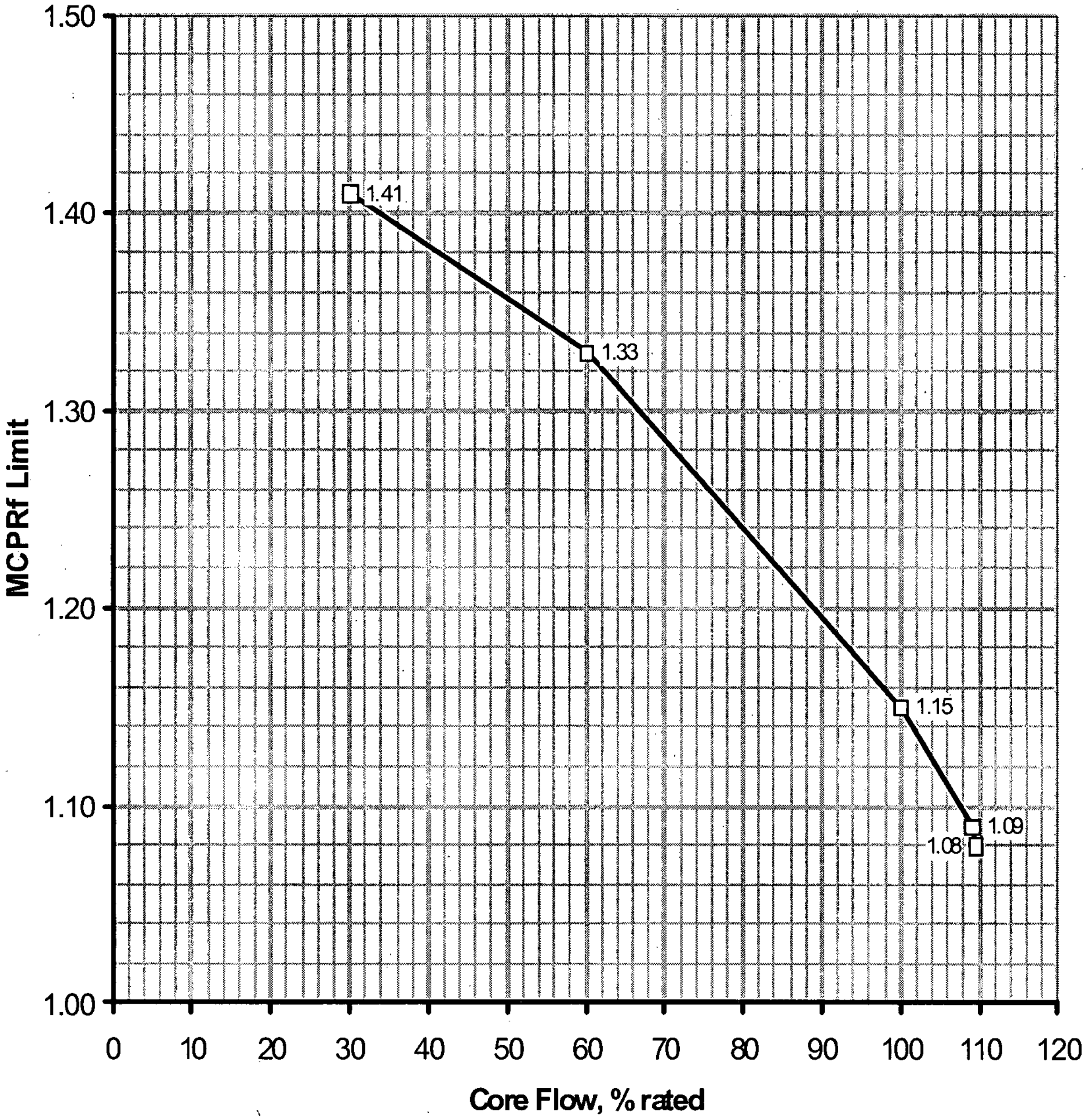


FIGURE 5. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10, EXPOSURE RANGE BOC TO EOC

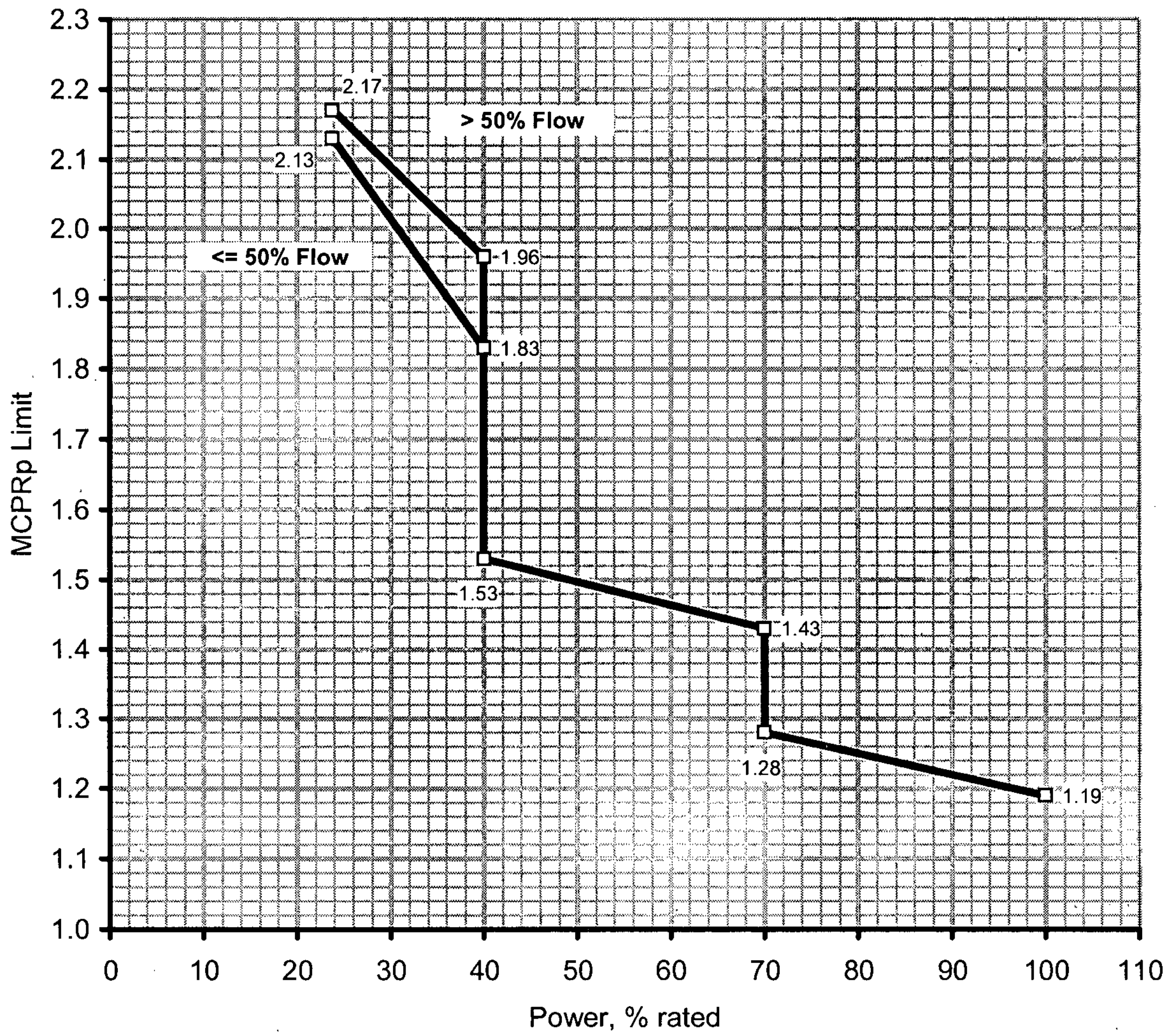


FIGURE 6. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10, EXPOSURE RANGE EOC TO EEOC

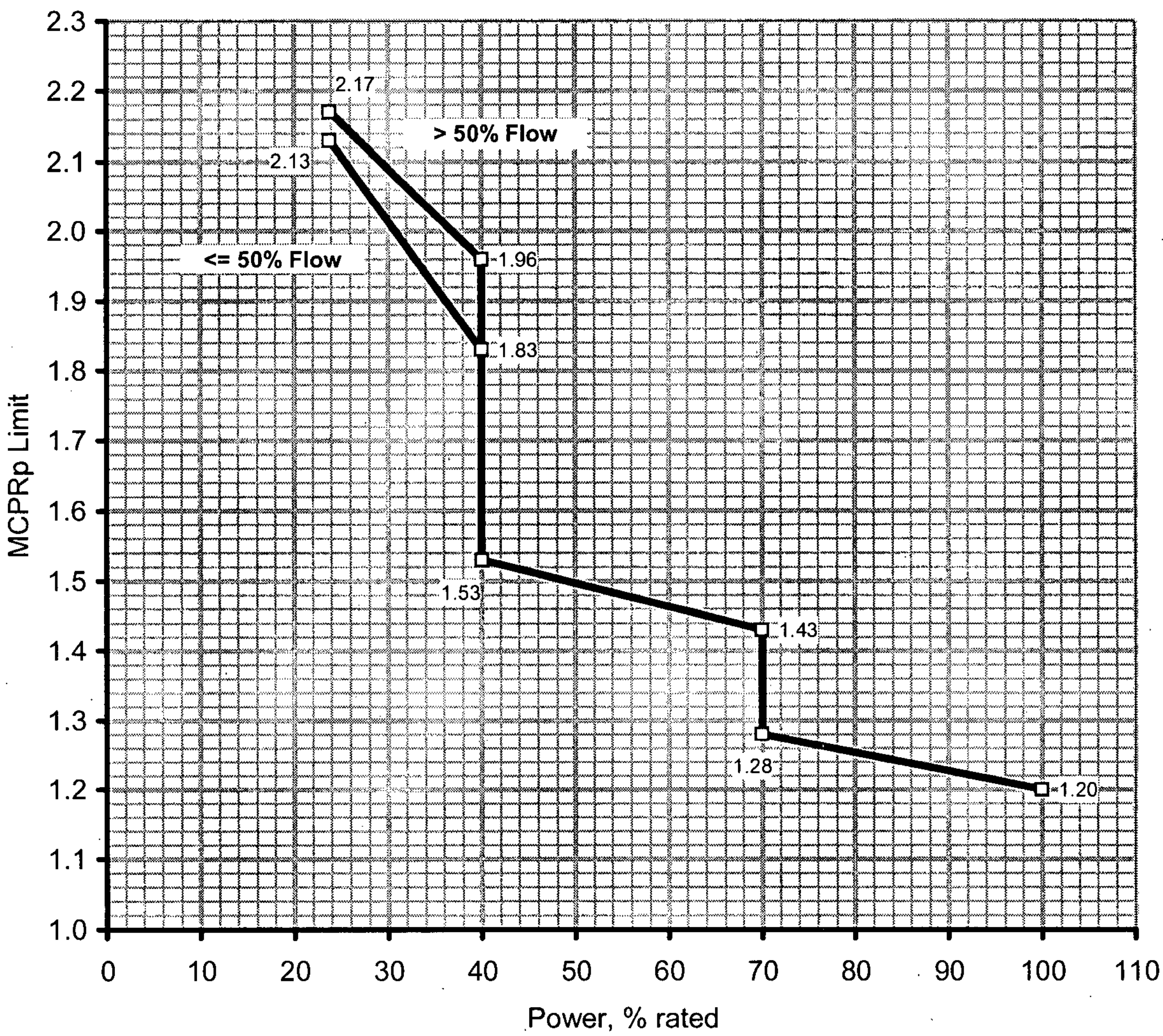


FIGURE 7. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10, EXPOSURE RANGE EEOC TO EEEOC

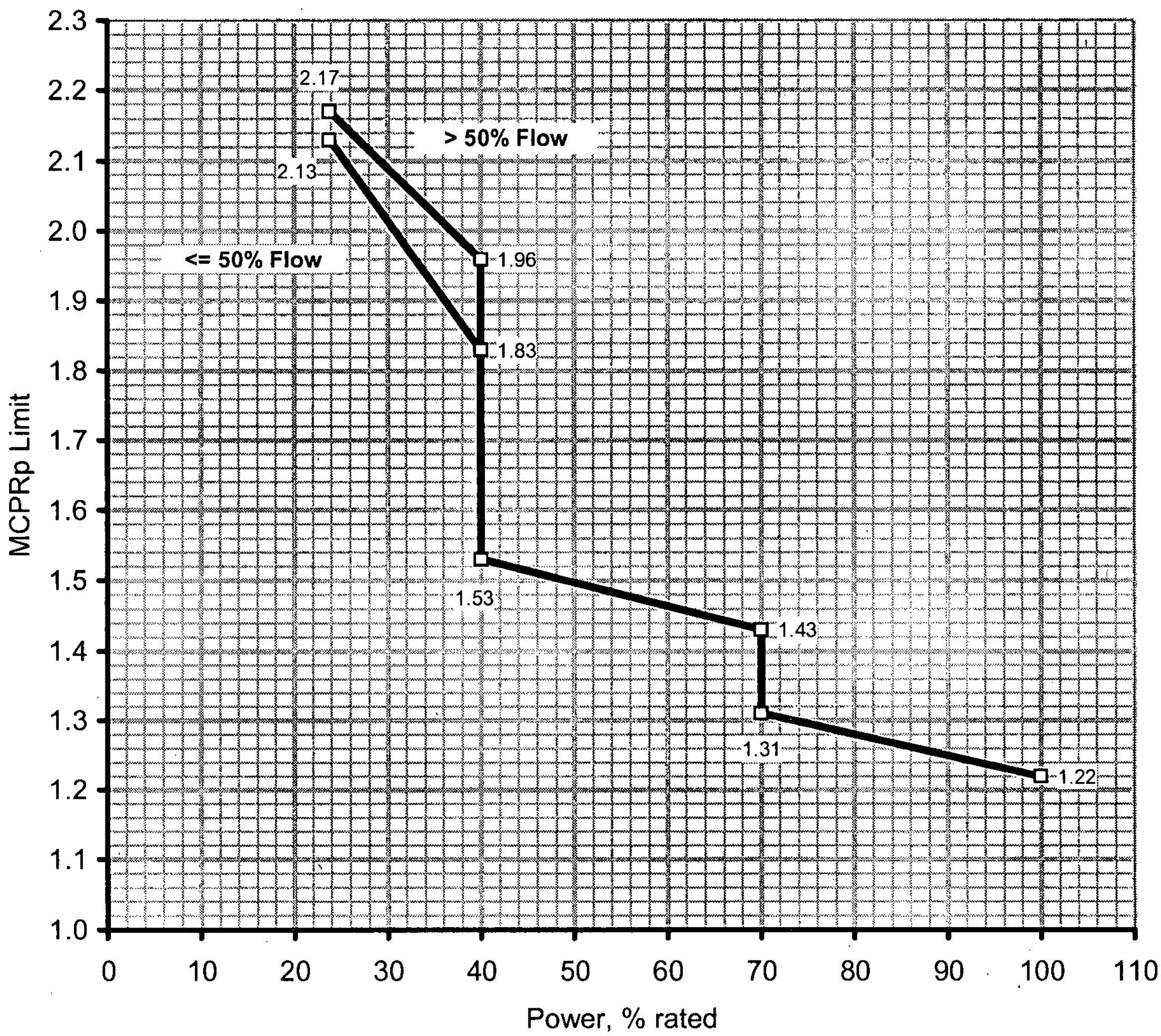


FIGURE 8. LHGR MULTIPLIER VERSUS CORE POWER FOR ALL ATRIUM-10, EXPOSURE RANGE BOC TO EEOC

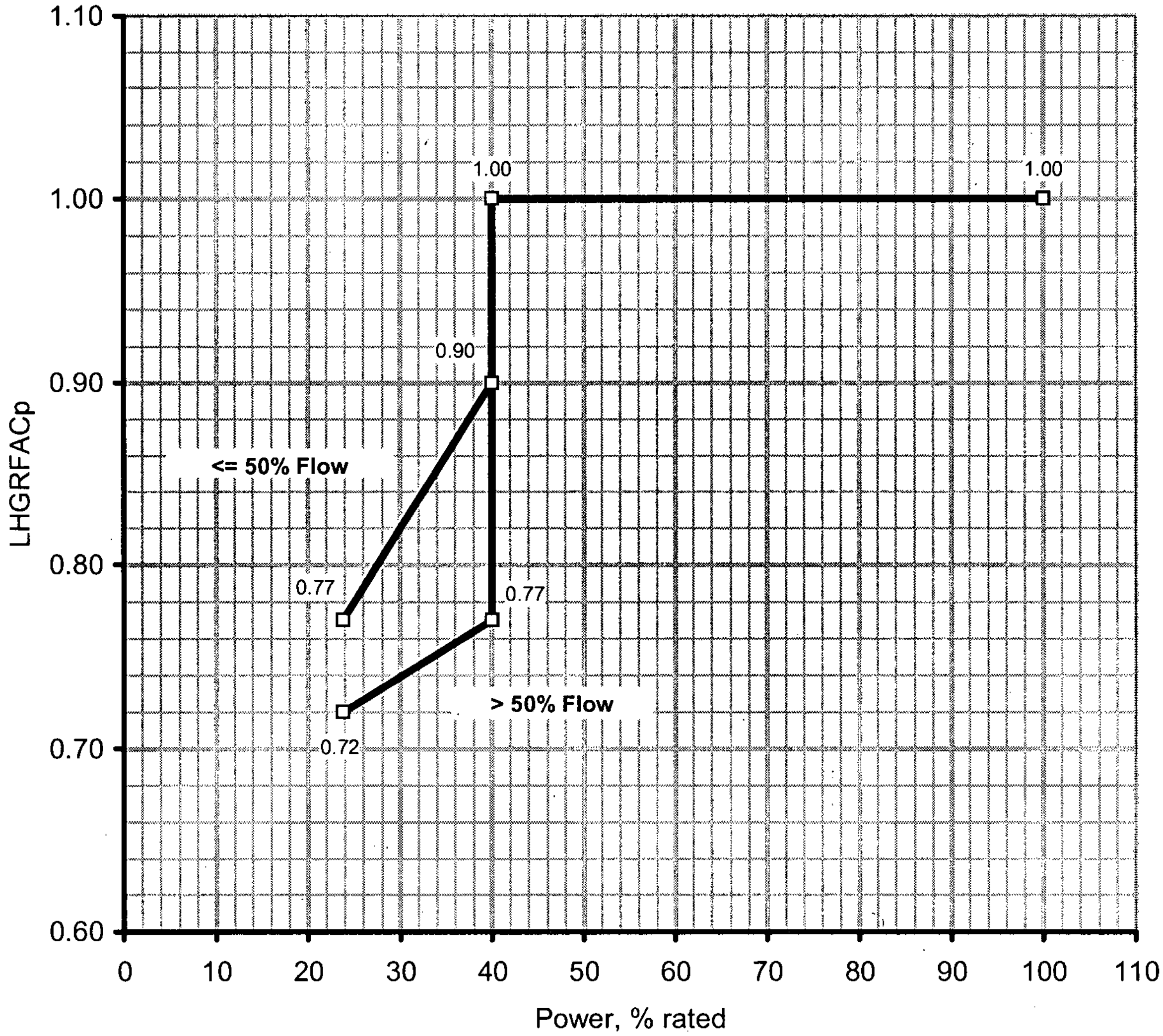


FIGURE 9. LHGR MULTIPLIER VERSUS CORE POWER FOR ALL ATRIUM-10, EXPOSURE RANGE EEOC TO EEEOC

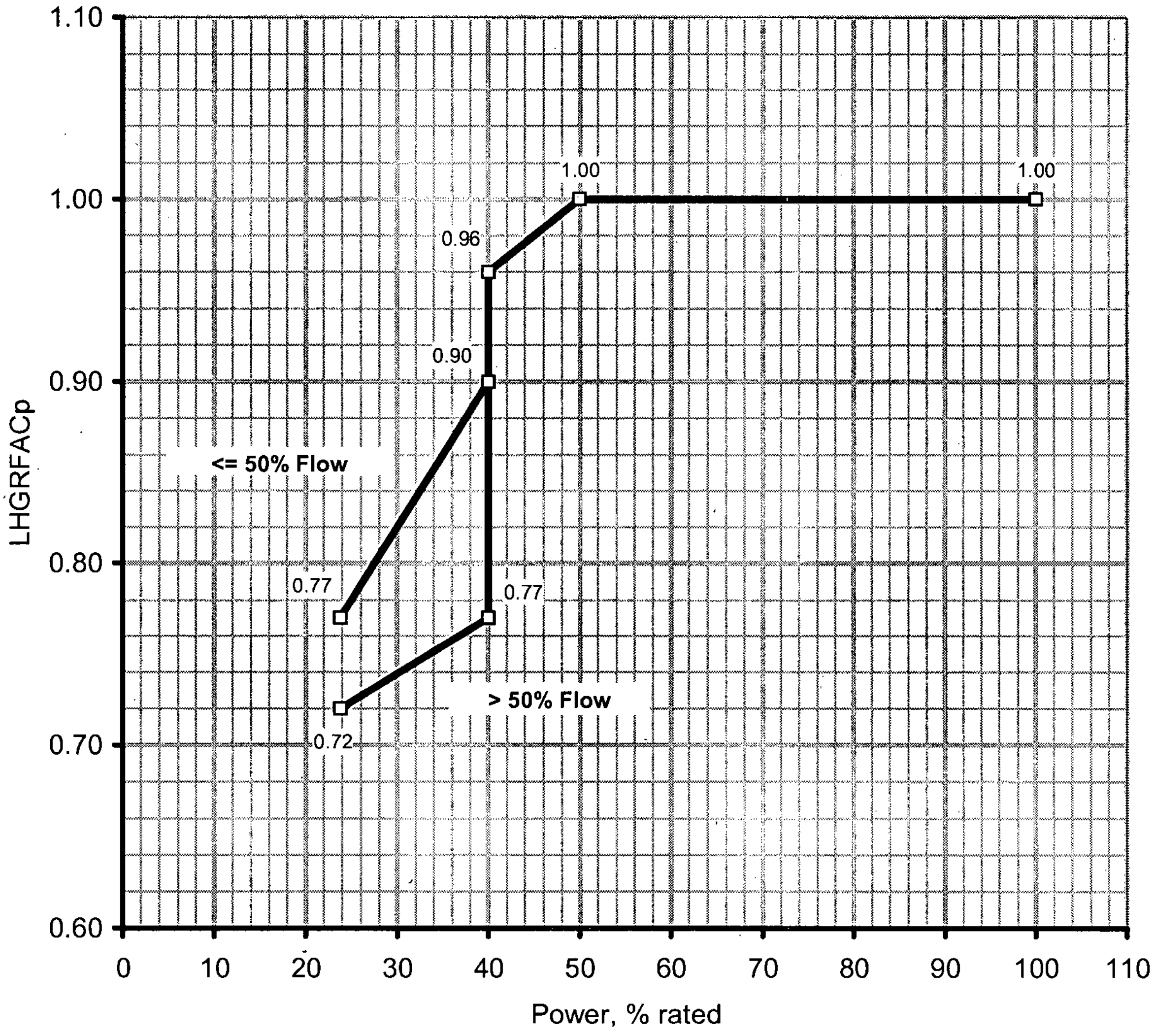


FIGURE 10. LHGR MULTIPLIER VERSUS CORE FLOW FOR ALL ATRIUM-10, ALL EXPOSURES

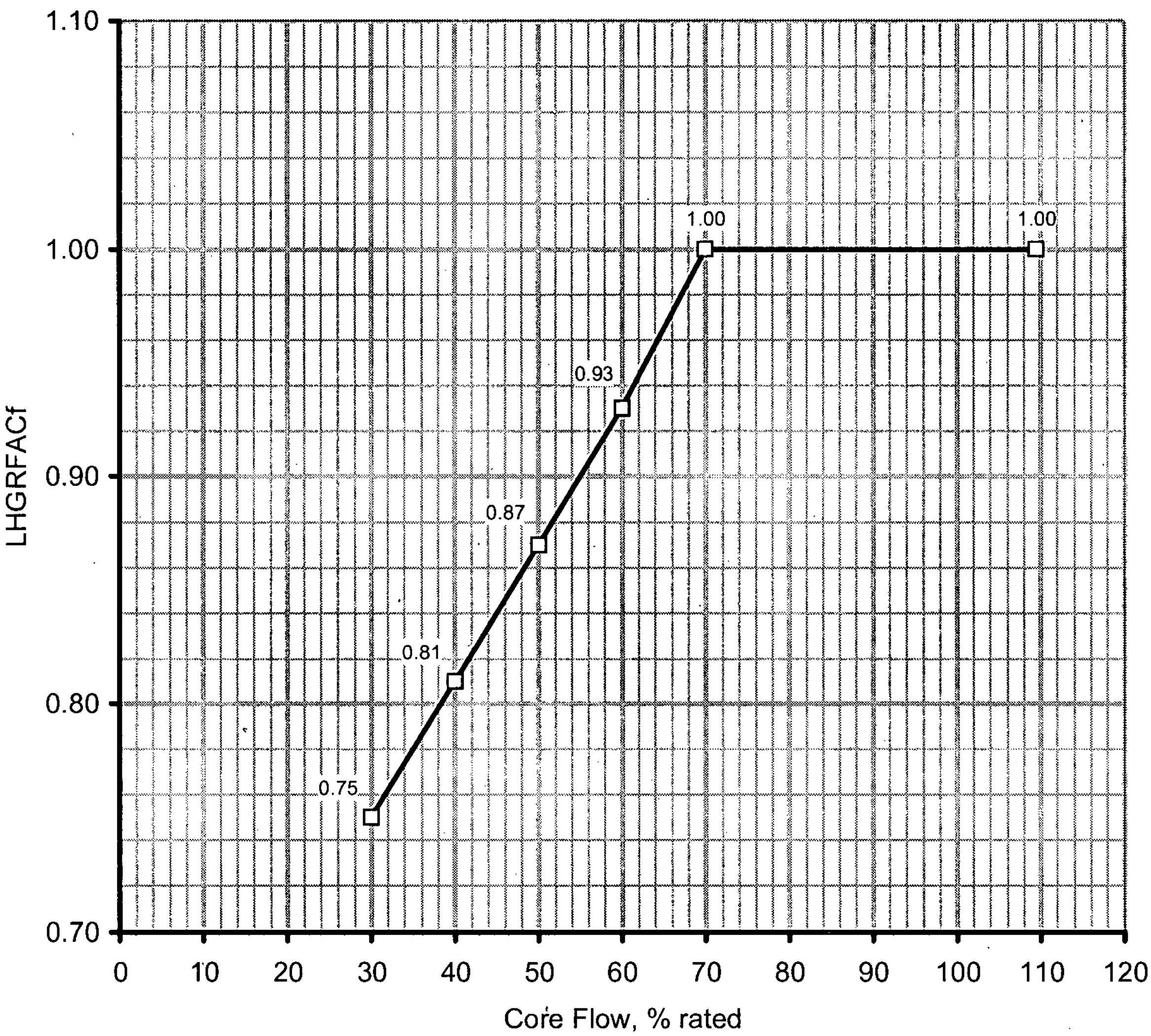


FIGURE 11. MONITORED REGION BOUNDARY (CASE 1)

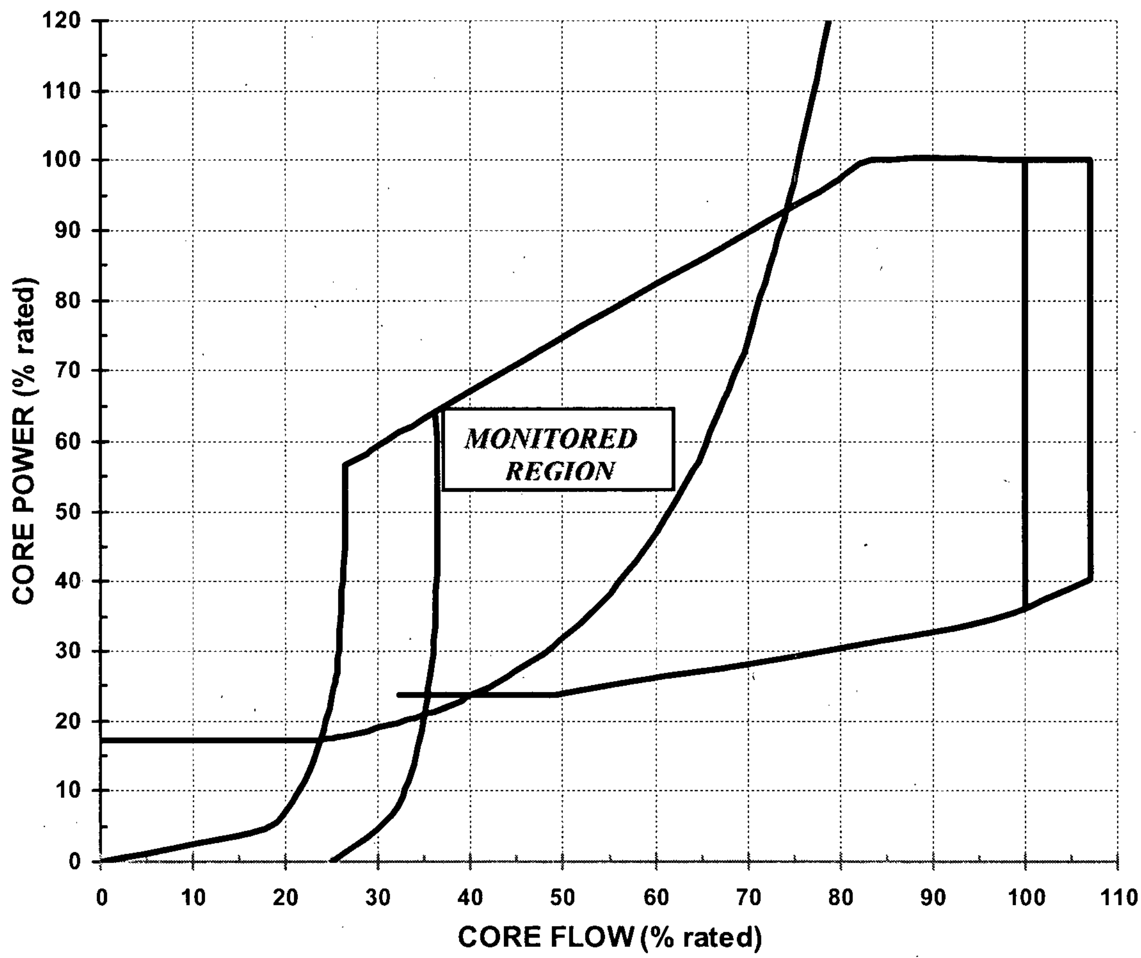


FIGURE 12. MONITORED REGION BOUNDARY (CASE 2)

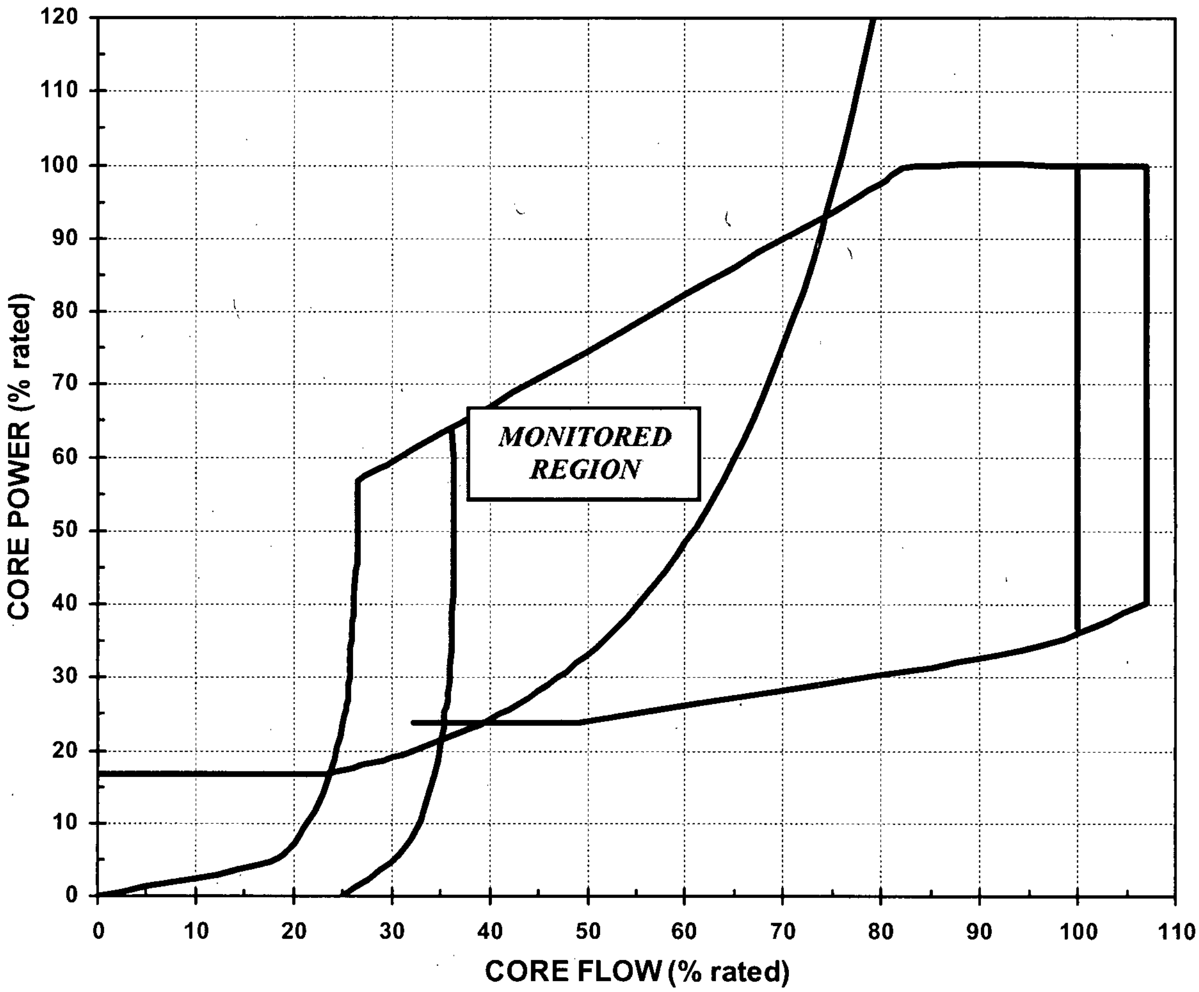


FIGURE 13. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(TWO RECIRCULATION LOOP OPERATION - CASE 1)

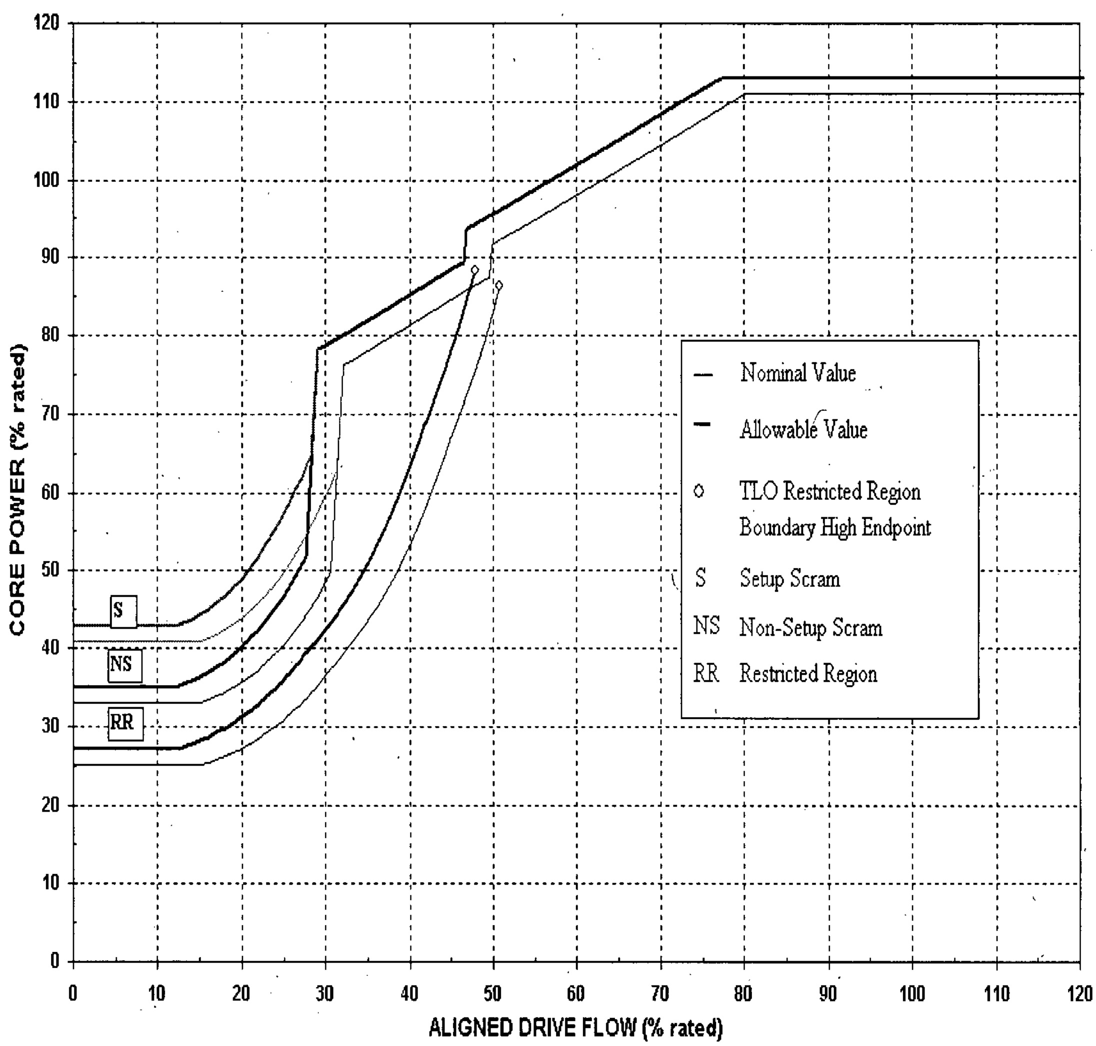


FIGURE 14. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(SINGLE RECIRCULATION LOOP OPERATION - CASE 1)

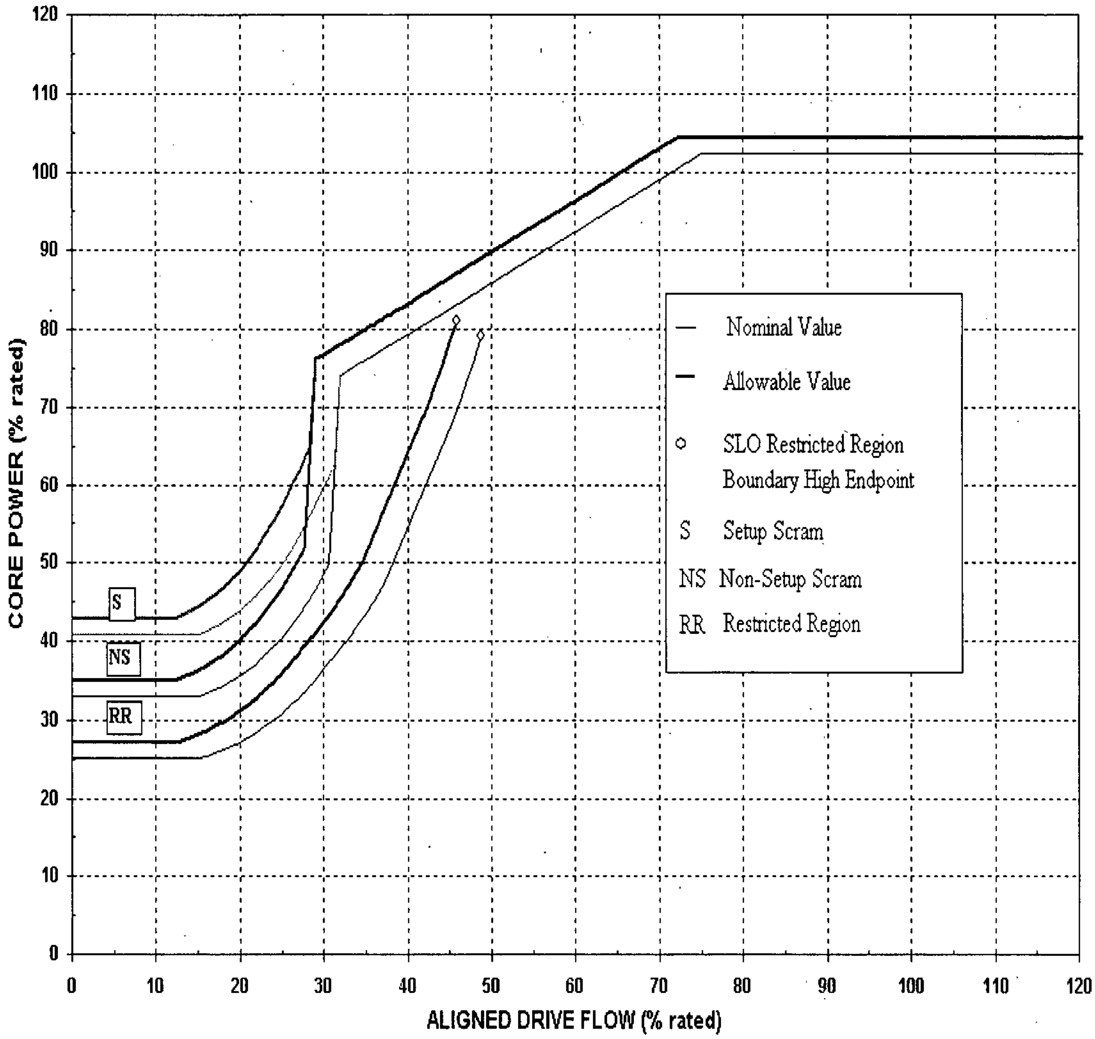


FIGURE 15. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(TWO RECIRCULATION LOOP OPERATION - CASE 2)

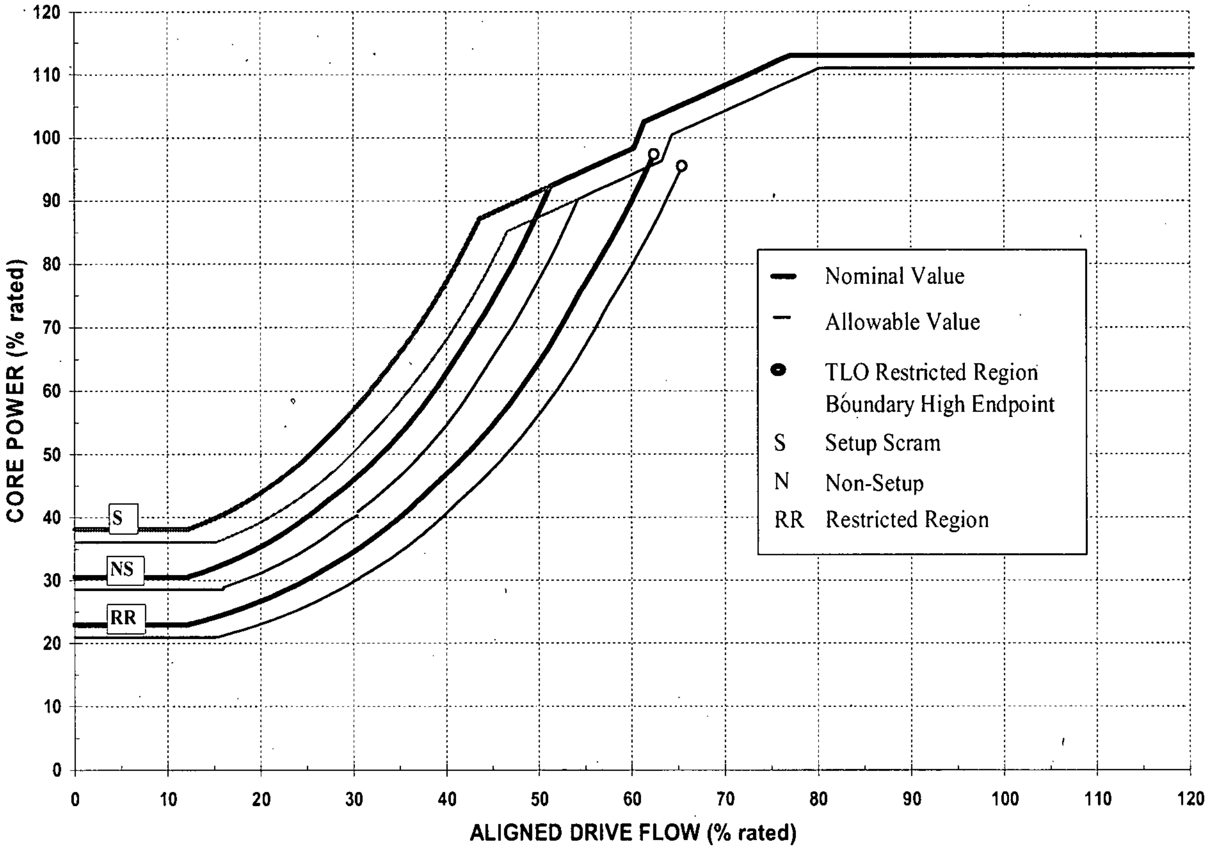


FIGURE 16. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(SINGLE RECIRCULATION LOOP OPERATION - CASE 2)

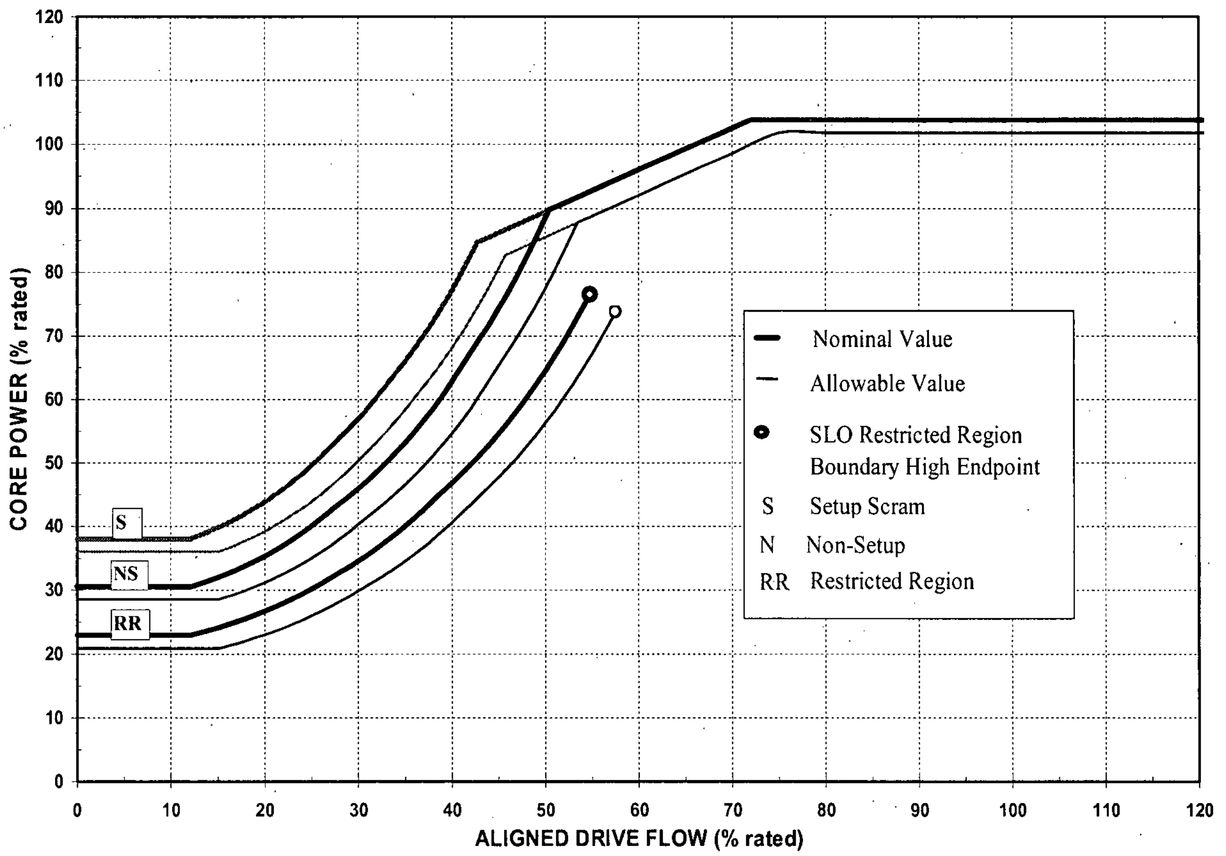


FIGURE 17. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(TWO RECIRCULATION LOOP OPERATION - CASE 1)

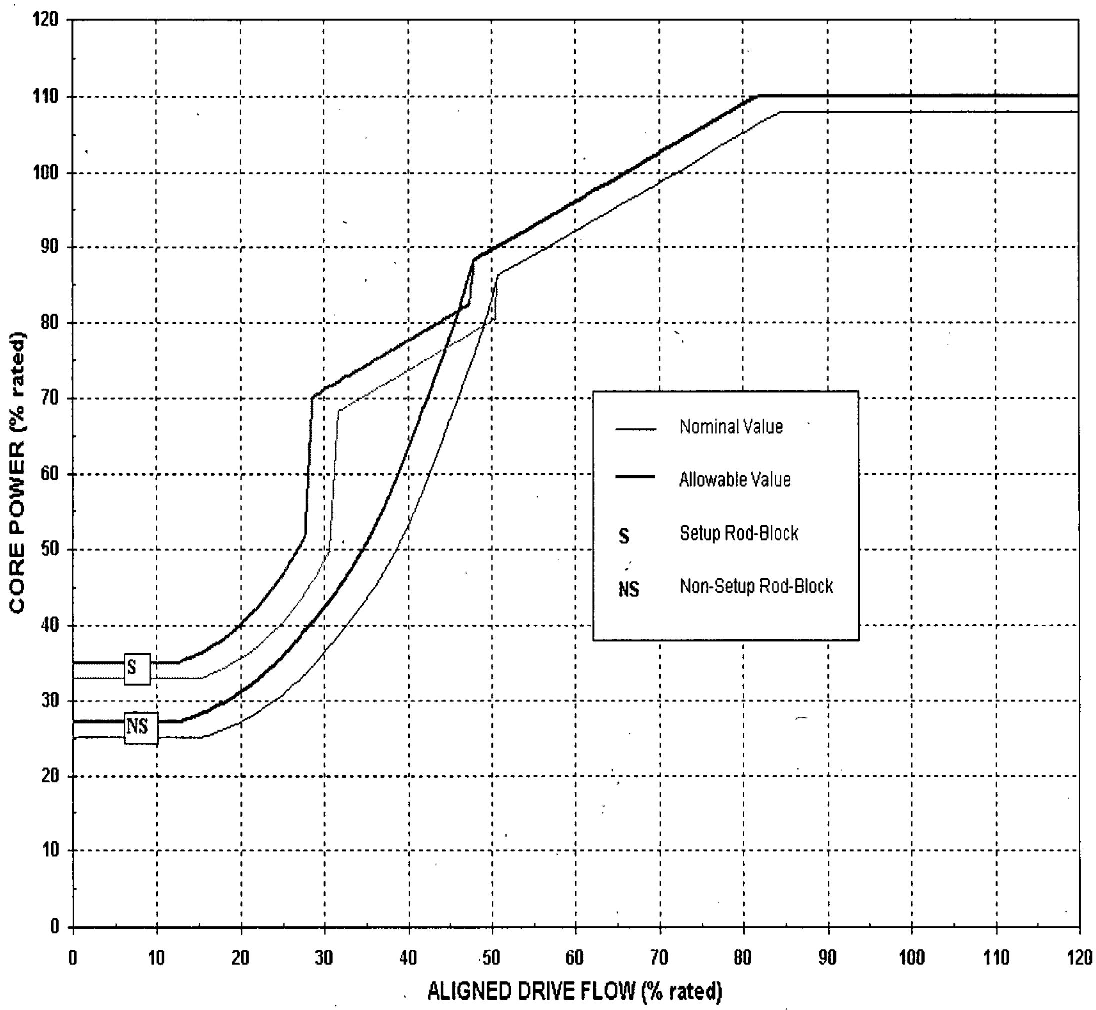


FIGURE 18. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(SINGLE RECIRCULATION LOOP OPERATION - CASE 1)

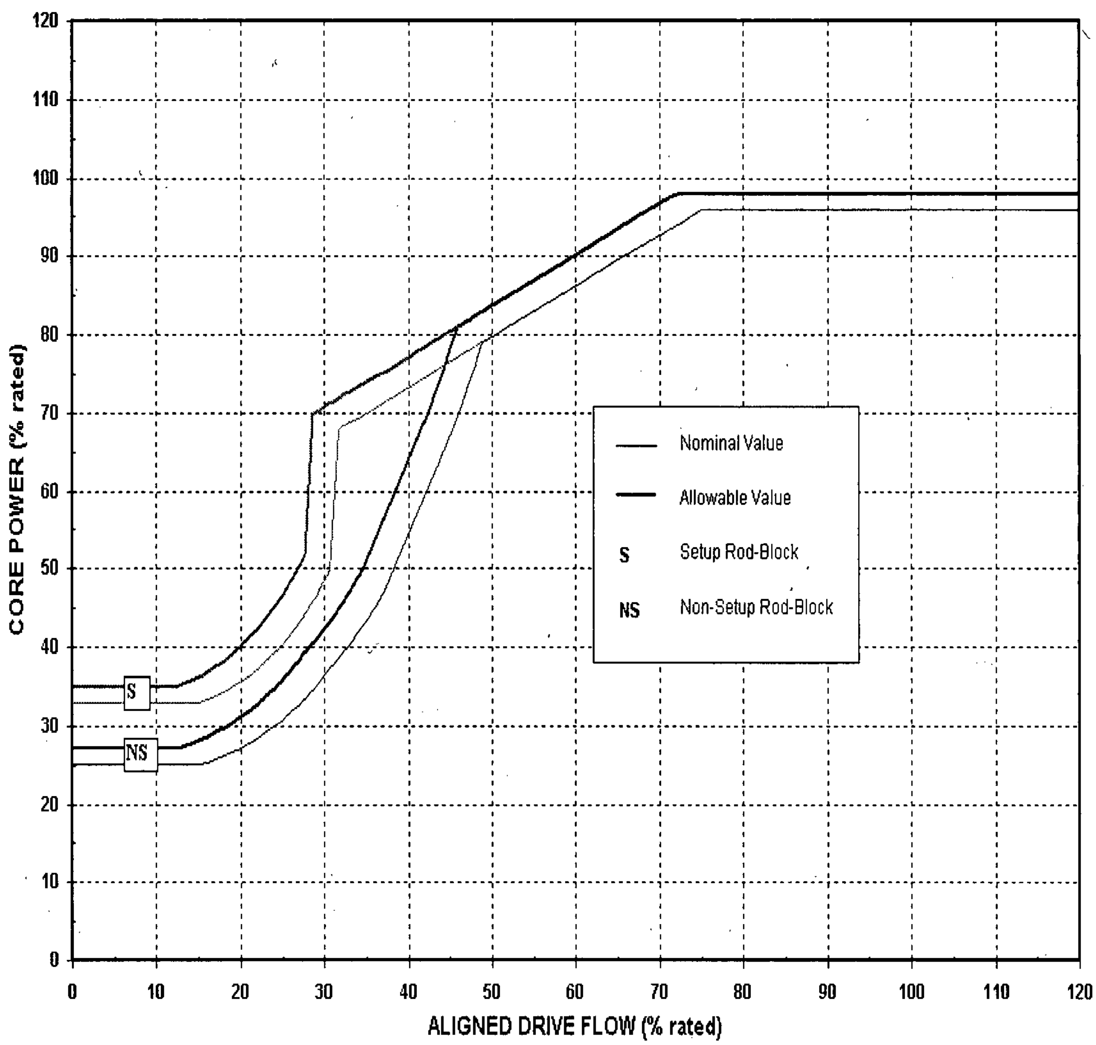


FIGURE 19. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(TWO RECIRCULATION LOOP OPERATION - CASE 2)

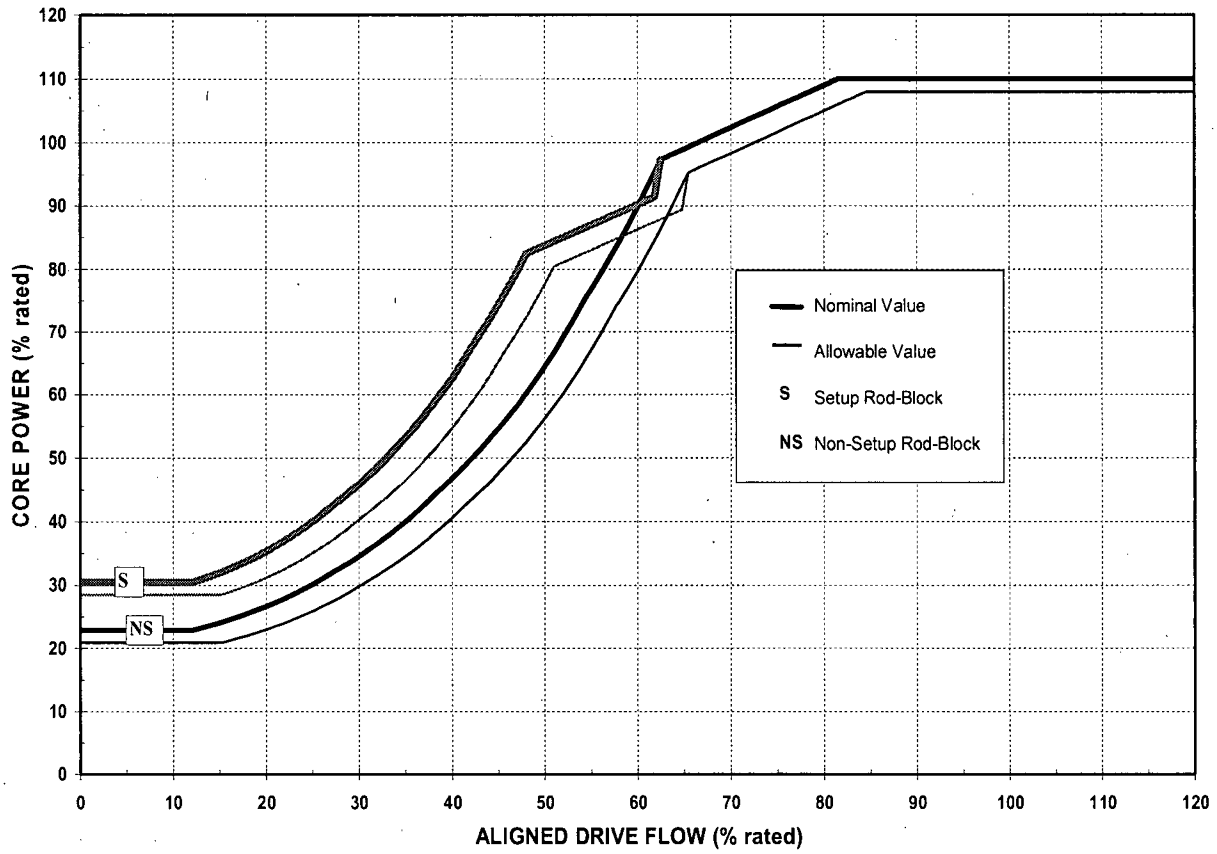
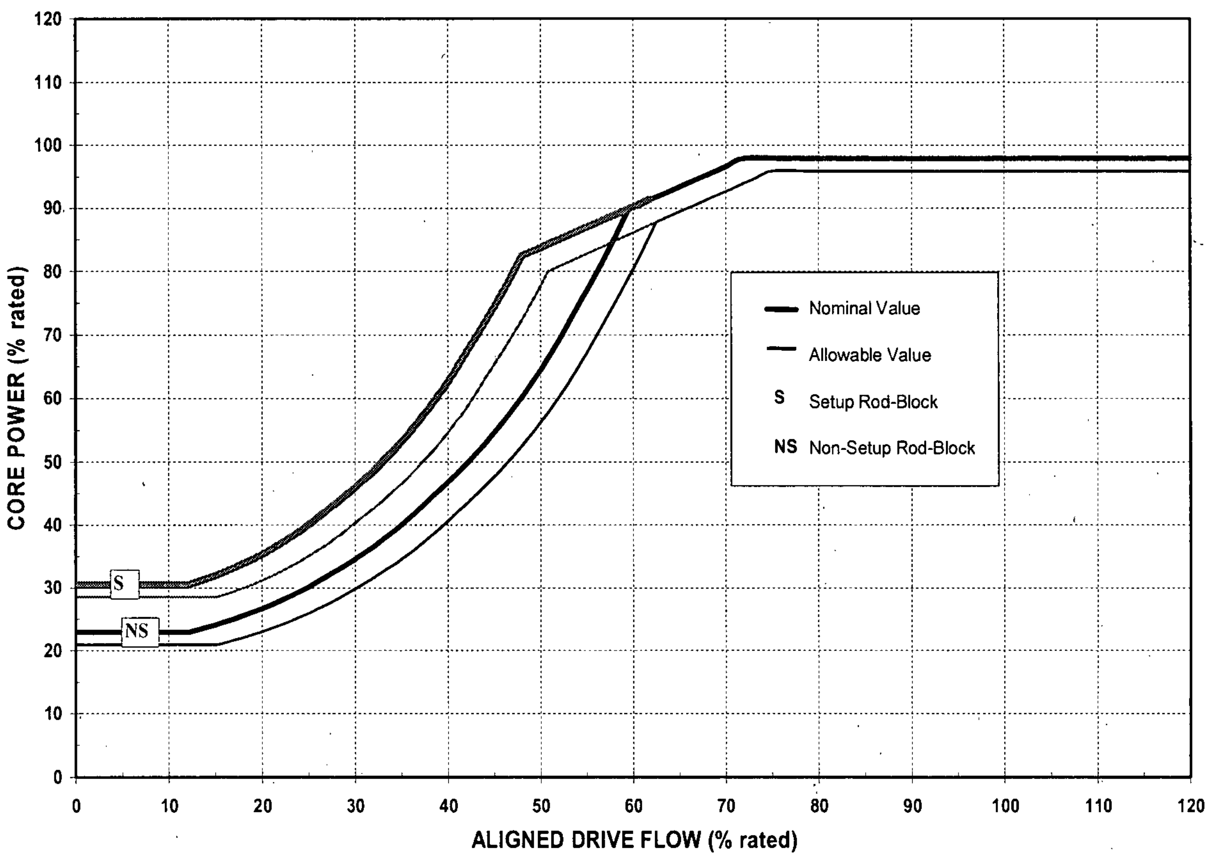


FIGURE 20. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(SINGLE RECIRCULATION LOOP OPERATION - CASE 2)



APPENDIX A

OPERATING LIMITS FOR EQUIPMENT OUT OF SERVICE OR LOOP MANUAL MODE

The operating limits listed in this appendix shall be used as indicated when operating in any of the following conditions:

- Feedwater Heater Out of Service (FHOOS) [(1)]
- Pressure Regulator Out of Service (PROOS) [(2)]
- Reactor Recirculation System in Loop Manual control.
- End of Cycle Recirculation Pump Trip (EOC-RPT) Inoperable [(1)]
- Single-Loop Operation (SLO) [(3)]
- Turbine Bypass Out of Service (TBOOS) [(4)]

[(1)] Power dependent MCPR and LHGR limits are presented in Figures 21, 22 and 23. Flow dependent LHGR and MCPR limits are presented in Figures 10, 4 for loop auto and 10, 27 for loop manual.

[(2)] Power dependent MCPR and LHGR limits are presented in Figures 24, 25, and 26. Flow dependent LHGR and MCPR limits are presented in Figures 10, 4 for loop auto, and 10, 27 for loop manual.

[(3)] The power dependent MCPRp for normal operation (Figures 5, 6 and 7) and equipment out of services (EOOS) described in (1), (2), and (4) shall be increased by 0.02 for SLO. The limits of APLHGR (Figure 2) shall be reduced to a value of 0.95 times the two recirculation loop operation limit when in single loop operation (Reference 1).

[(4)] Power and Flow dependent MCPR and LHGR limits are presented in Figures 21, 22, 23, 25, 26, 28 for loop auto, and 27 for loop manual.

Note: Power dependent MCPR and LHGR limits for an operating mode at EEEOC exposure point may be used to bound all cycle exposures

FIGURE 21. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10

BOUNDING FHOOS, TBOOS AND EOC-RPT INOPERABLE

BOC TO MOC

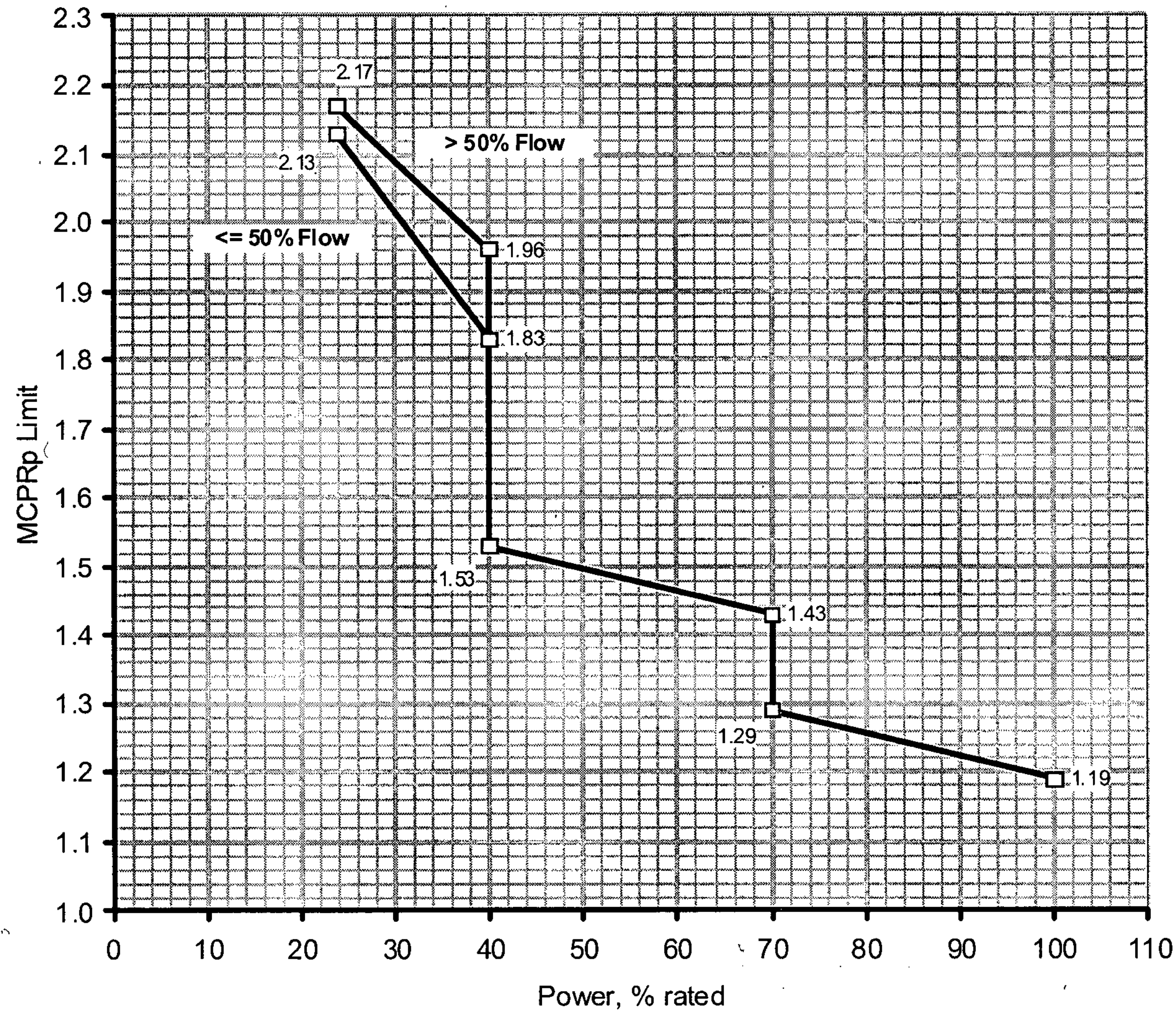


FIGURE 22. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10

BOUNDING FHOOS, TBOOS AND EOC-RPT INOPERABLE

MOC TO EEEOC

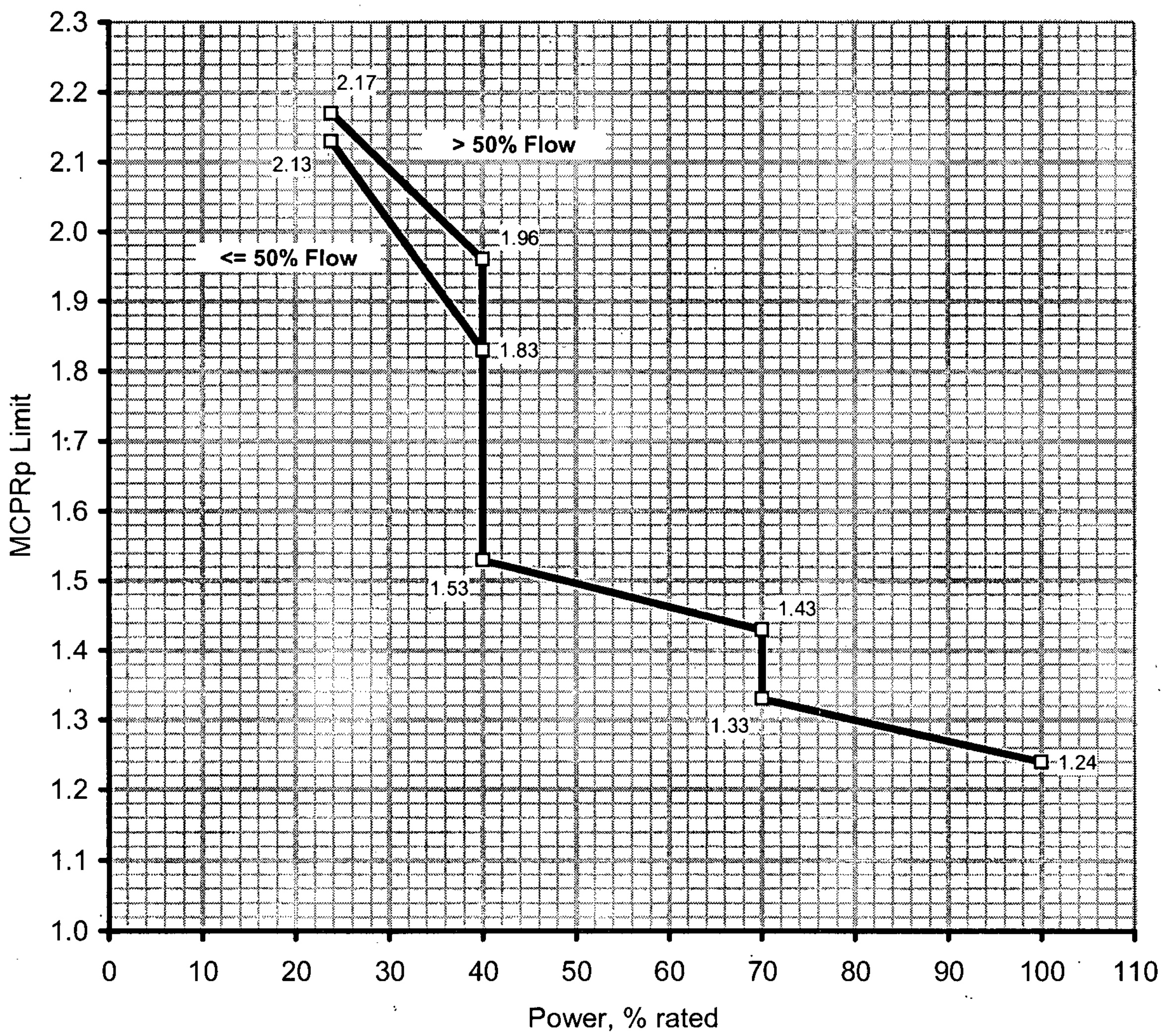


FIGURE 23. LHGR MULTIPLIER VERSUS CORE POWER FOR ATRIUM-10

BOUNDING FHOOS, TBOOS AND EOC-RPT INOPERABLE

ALL EXPOSURES

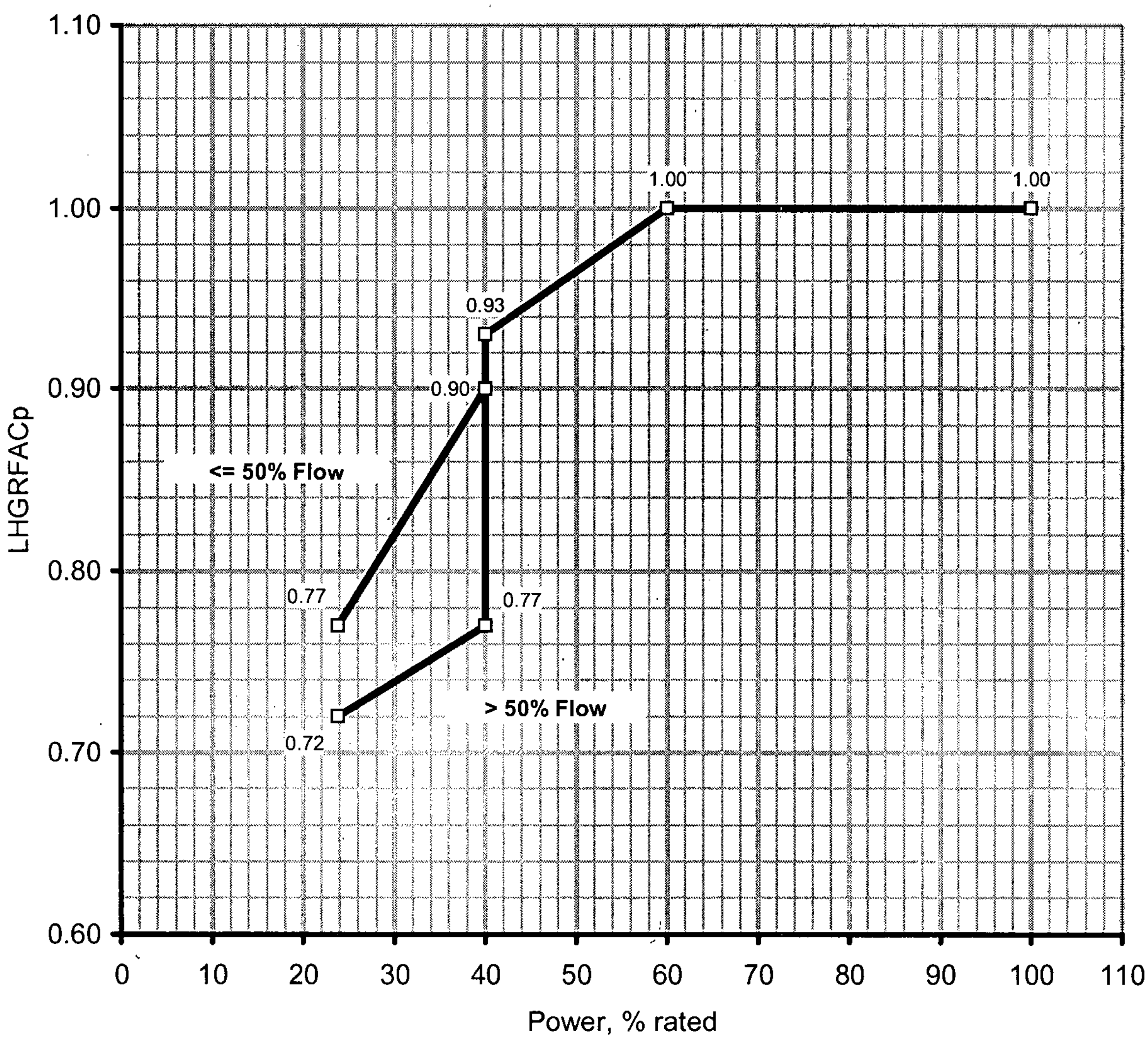


FIGURE 24. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10, PRESSURE REGULATOR OUT OF SERVICE (PROOS), BOC TO EEOC

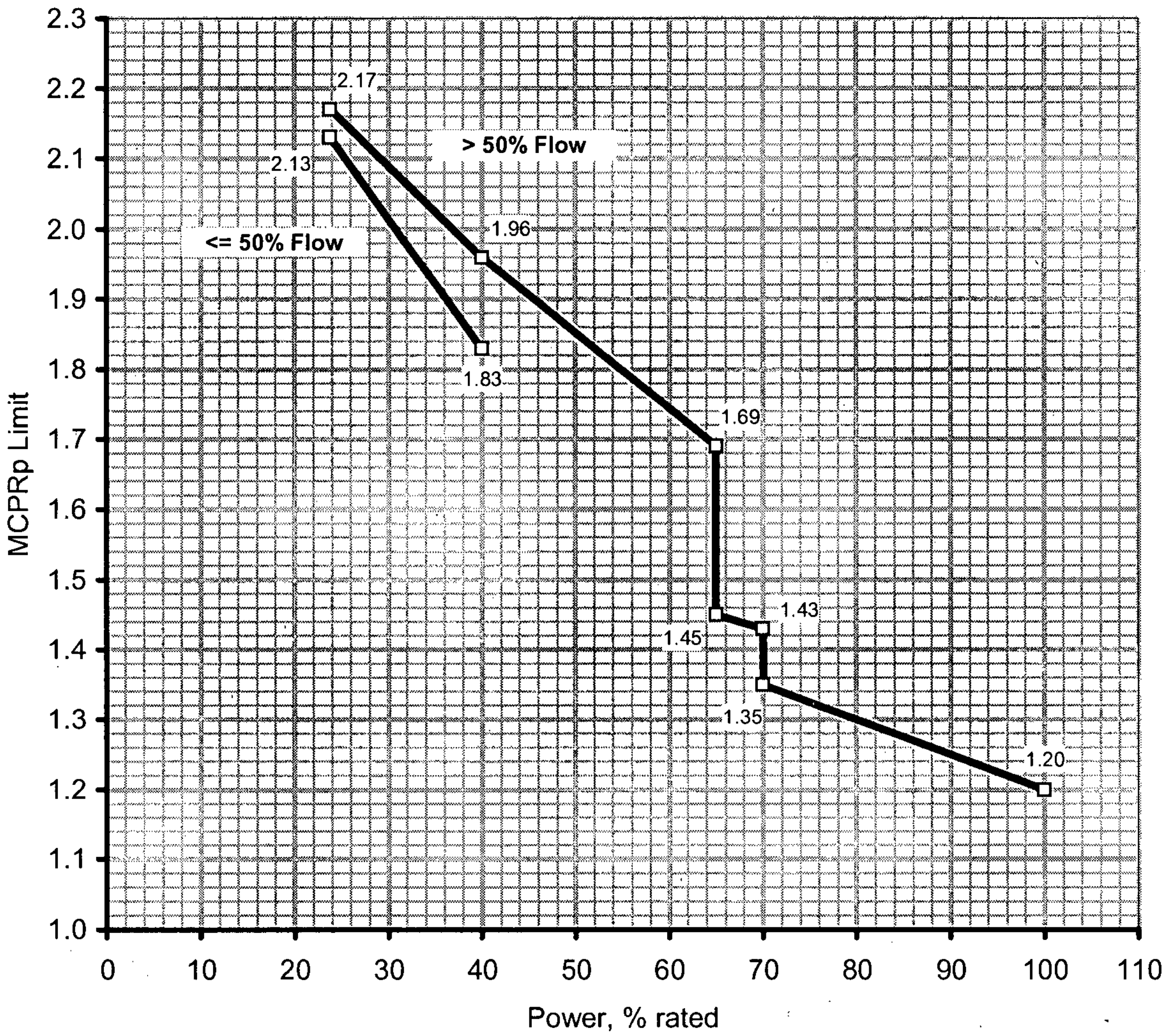


FIGURE 25. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER FOR ATRIUM-10

BOUNDING FHOOS, PROOS, TBOOS AND EOC-RPT INOPERABLE

ALL EXPOSURES

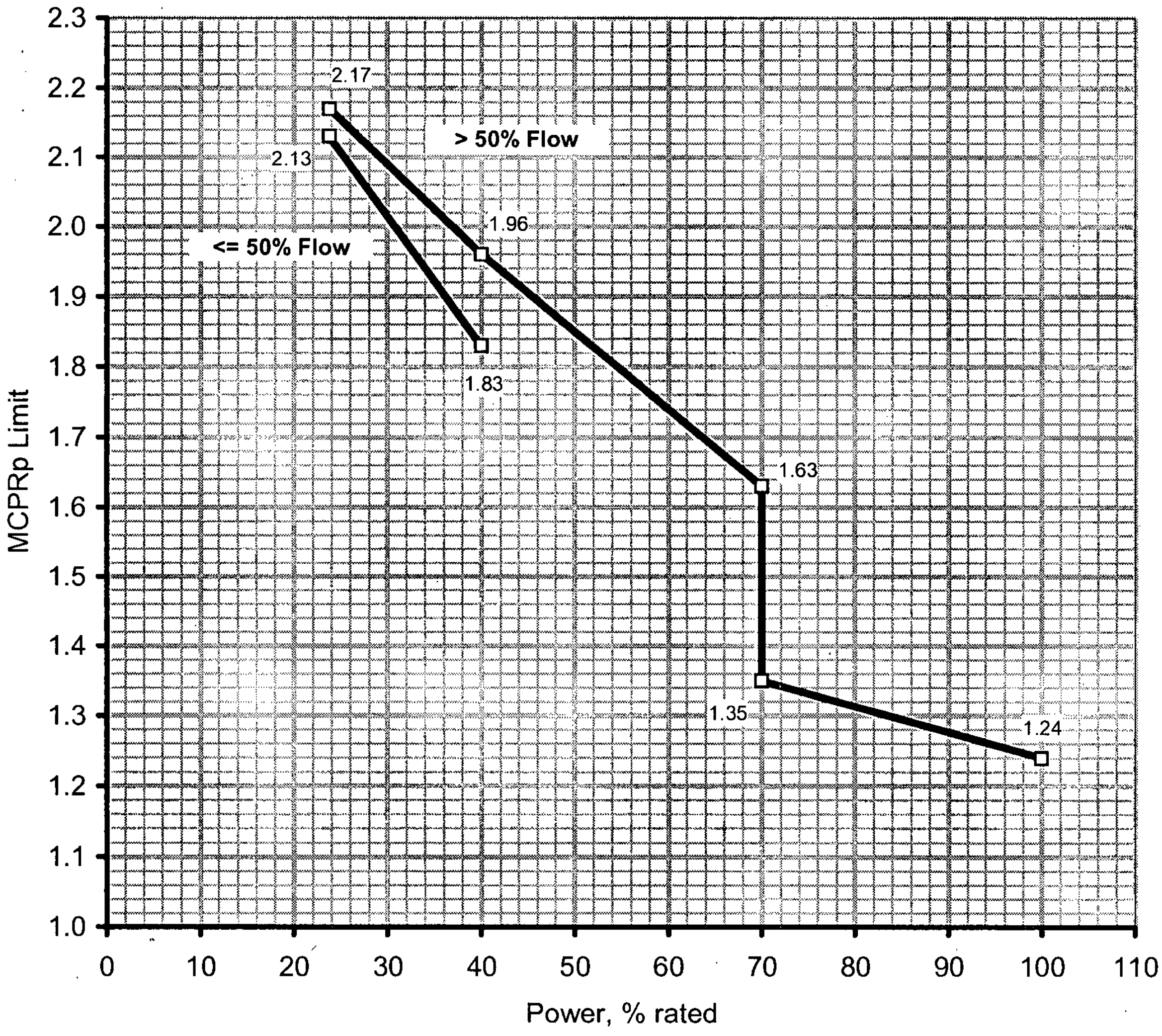


FIGURE 26. LHGR MULTIPLIER VERSUS CORE POWER FOR ALL ATRIUM-10

BOUNDING FHOOS, PROOS, TBOOS AND EOC-RPT INOPERABLE

ALL EXPOSURES

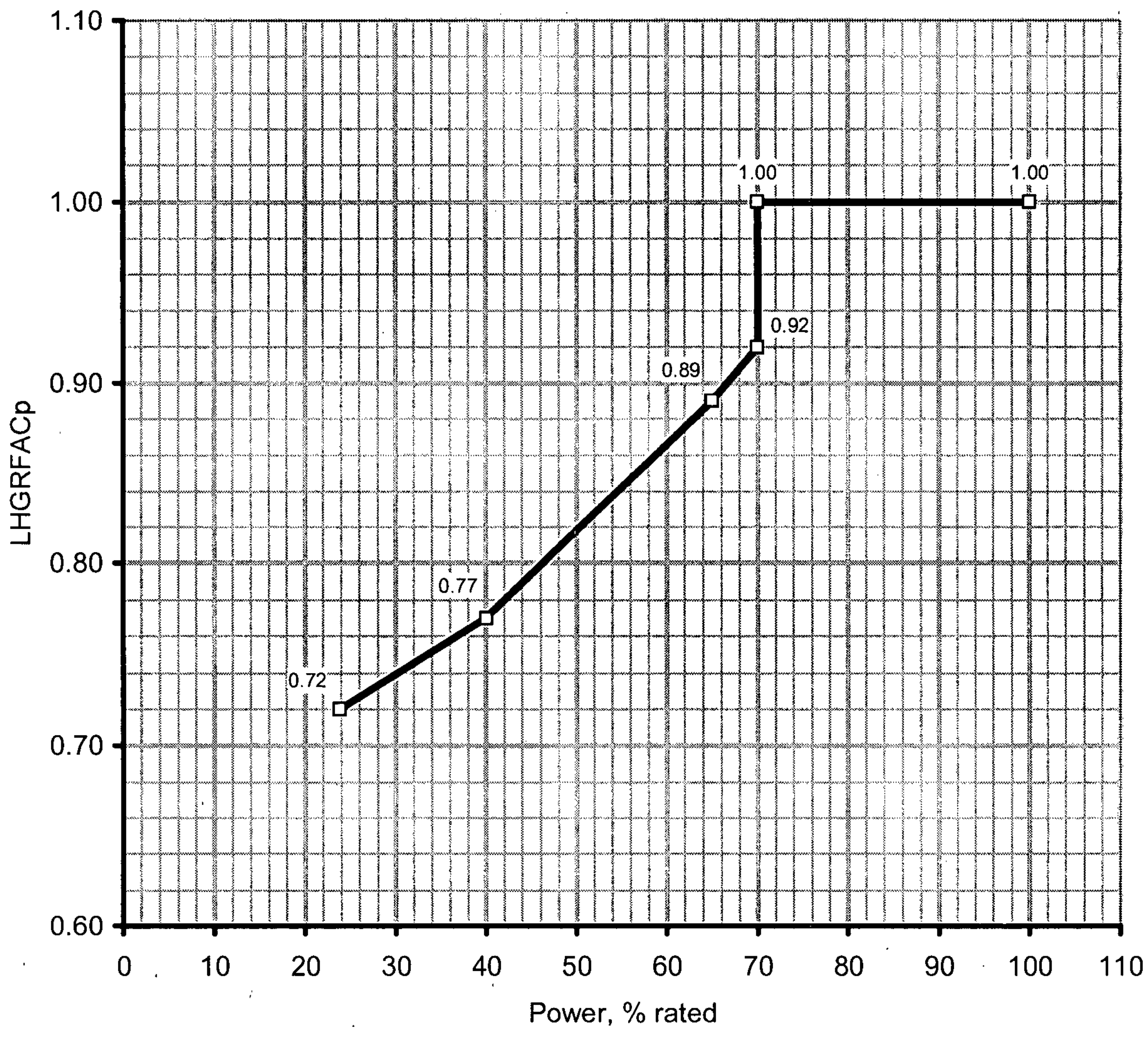


FIGURE 27. OPERATING LIMIT MCPR ($MCPR_F$) VERSUS CORE FLOW FOR ATRIUM-10 FOR RECIRCULATION SYSTEM IN LOOP MANUAL

ALL EXPOSURES

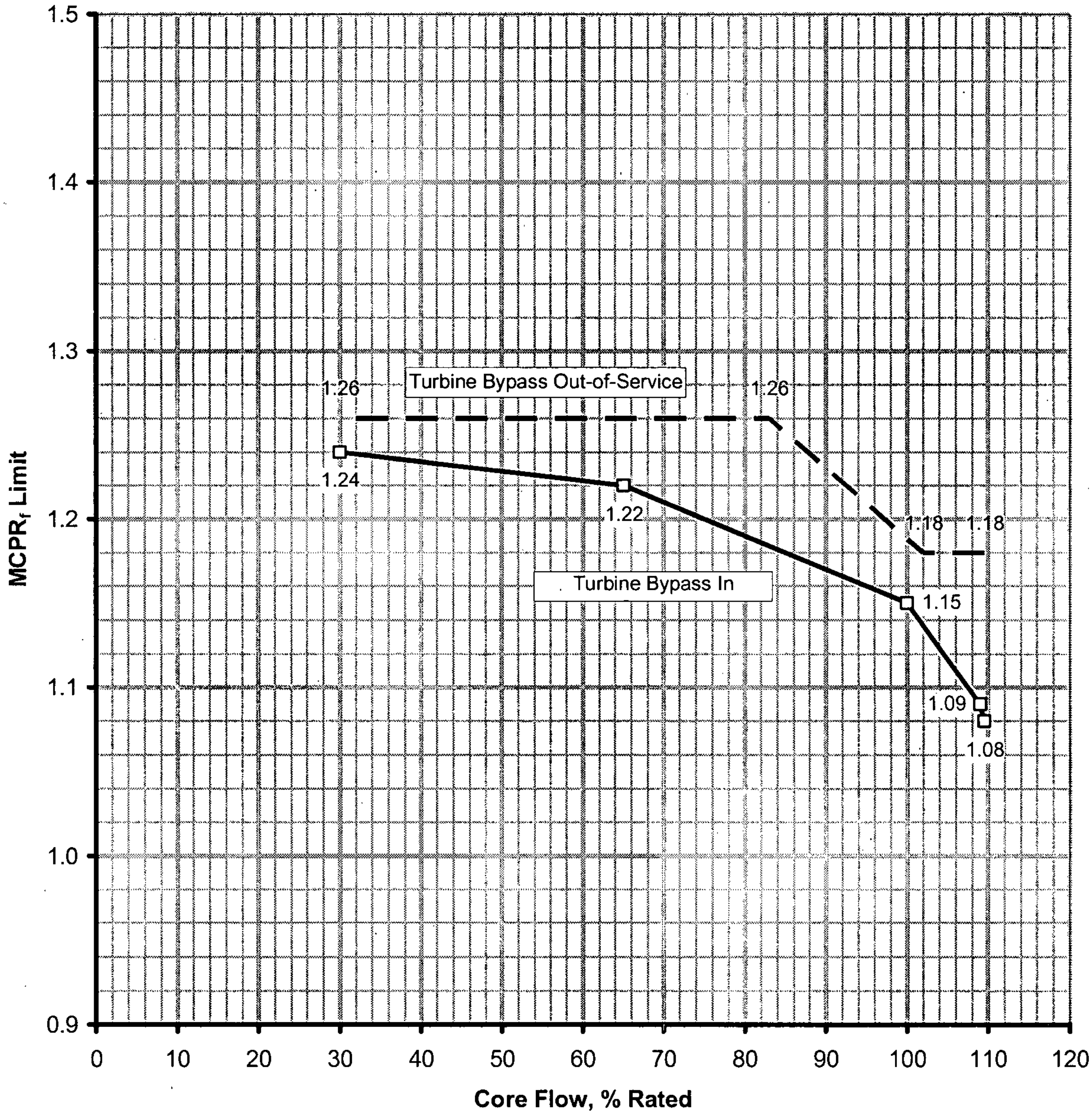


FIGURE 28. OPERATING LIMIT MCPR ($MCPR_F$) VERSUS CORE FLOW FOR ATRIUM-10 FOR RECIRCULATION SYSTEM IN LOOP AUTO CONTROL, TBOOS, ALL EXPOSURES